Illinois Department of Commerce and Economic Opportunity
Bureau of Energy and Recycling

Municipal Solid Waste . . .

and the 4Rs

Reduce • Reuse • Recycle • Re-buy

An Illinois Middle School Teacher's Guide

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An Illinois Middle School Teacher's Guide

Developed by
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For
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Bureau of Energy and Recycling

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Preface

An Introduction and Overview

This manual has been designed for use at the middle school level in classrooms where instruction dealing with municipal solid waste (MSW) and the 4Rs - reduce, reuse, recycle, re-buy - is felt important. What separates this document from many others is the methodology as well as the scope and the sequence found here. The methodology focuses on issue investigation and the skills associated with it. The investigation skills methodology* employs a broad, more generalizable approach to the process of issue investigation. The intent of this methodology is to develop in students the skills involved in issue investigation, evaluation, and resolution: capabilities which can be used throughout their lives as citizens.

The issue investigation skills strategy uses instructional activities structured around four issue investigation goal levels. This investigation skills method defines, practices, and applies the generic knowledge and skills needed by learners to independently investigate and resolve a variety of issues. This process culminates in an investigation of an issue of the student's own choosing and the development of an action plan for resolving that issue.

The MSW and the 4Rs program presented here is organized into a series of four chapters. The chapters are interdisciplinary in nature and introduce students to the characteristics of issues, the skills needed for obtaining and processing information, the skills needed for analyzing and investigating issues, and those skills needed by responsible citizens for issue resolution. An issue investigation can be described as the systematic process of asking and answering an important question or series of questions about an issue.

The program presented in this manual recommends that the teacher begin with Chapter 1 and proceed through the manual as it is presented. Instruction begins with information about MSW and the 4Rs and moves to a discussion of major disposal techniques. From here the teacher introduces the student to the concept of "problems" and "issues" and helps the learner gain those skills necessary in understanding the anatomy and social impact of issues. Next, students move to the investigation of community-based issues and then to the critical aspects of responsible citizenship actions regarding MSW and the 4Rs.

The instructional model around which this sequence is organized is both research based and research proven. Used in its entirety, it holds definite promise for helping young learners become more responsible citizens in their own communities.

Why should your class do issue investigations? There seem to be several payoffs for students. Issue investigations allow students to learn about issues through direct, "hands-on"

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* **This methodology has been formalized and published by Stipes Publishing Company in *Investigating and Evaluating Environmental Issues and Actions: Skill Development Program* (Hungerford, et al., 1996). This program is currently in use in grades 5-12 in numerous schools across the U.S.**

involvement. This is an exciting way to learn. Students also learn a great deal about MSW and the 4Rs as well as how scientific research methods work. And, an issue investigation is an important way to make sure that students have all the critical information they will need before beginning to make decisions about solving a MSW issue.

Who should use this guide?

This solid waste/4Rs teacher's guide is designed especially for teachers who wish to be responsive to students' interests. When middle school students are asked about topics that are important to them, the environment ranks at the top of the list. Although there are many, many environmental issues, one of the most important to students is solid waste. Illinois, as well as the rest of the nation, is facing a tremendous challenge in finding rational approaches to the question of what to do with the municipal solid waste we produce. This challenge has received a great deal of attention in the press and in civic debate. As a result, students want to know more about the topic. More importantly, they want to help if they can. And they can!

The approach used by this guide crosses educational boundaries - it provides a strong scientific background on solid waste issues and the 4Rs, while offering key lessons in the importance of becoming informed and responsible citizens. For these reasons, this guide will be of interest to teachers of science and social studies alike. It will appeal to science teachers who want the information and skills they teach to lead ultimately to responsible citizenship action. It will also appeal to social studies teachers who want to go beyond the discussions of citizenship and engage their students in real-world problems toward which their students can make a demonstrable difference. The program described could be taught across several subjects and grade levels.

How is this guide organized?

This guide describes a complete course of study, taking students from issue awareness through issue analysis and investigation to responsible citizen action. It will introduce information on solid waste and its management and then help your students develop important skills which will permit them to ask pertinent questions about solid waste and recycling concerns in your own community and to access relevant information to use in their decisions about possible solutions. It is organized into a skill-building approach and, as such, it is most valuable when taught in its entirety. The guide consists of four chapters which reflect the following goal levels:

- ✓ **Goal Level 1, Science Foundations.** This chapter contains background information on solid waste, on various methods of dealing with solid waste, and on the Illinois laws and regulations which govern its disposal. Chapter 1 includes six student activities and a project which will involve students in the content of this goal level.

- ✓ **Goal Level 2, Issue Awareness.** This chapter teaches the skills associated with the critical analysis of solid waste and 4Rs issues, as well as the alternative solutions for these issues. Two student activities are provided in the guide, and you are encouraged to permit your students to apply issue analysis skills to local issues as well.

- ✓ **Goal Level 3, Issue Investigation.** This chapter provides a framework for you to use as you guide your students through a research project into local solid waste and 4Rs issues in your community. Eight activities are provided in this chapter.

- ✓ **Goal Level 4, Citizenship Action.** This chapter addresses responsible citizenship strategies and provides guidance in the development and evaluation of a plan to help resolve the solid waste/4Rs issue(s) of interest to your students. This chapter provides one comprehensive activity, which you might use to involve your students in planning and evaluating their proposed actions toward issues in your community.

How does this guide complement goals and standards from the Illinois Learning Standards?

The matrices presented on the following pages will assist Illinois teachers in implementing the content and skills taught through this guide. The first matrix describes the objectives found at the beginning of each chapter and identifies the Illinois Learning Standards with which they are consistent. The second matrix again lists the objectives and also identifies the specific standards addressed within each goal. This Teacher's Guide addresses all three of the science goals as well as those social studies goals which relate to economic, political and historical concerns. Moreover, English/language arts and math goals are also addressed, as the investigation of a solid waste/4Rs issue incorporates abilities from English and math into research of a real-life problem area. A complete listing of the Illinois goals and standards for these four subject areas is attached as Appendix A. (**PUBLISHER'S NOTE:** *While this guide has been designed and developed to dovetail with specific aspects of the Illinois Learning Standards applicable for middle school students, the guide is believed to be sufficiently comprehensive to also be appropriate for use with high school students as individual circumstances dictate.)*

In addition, the approach taken by this guide lends itself well to attendance to the Applications of Learning (also found in Appendix A) identified within the Illinois Learning Standards document. These applications of learning are significant methods of learning and using knowledge. They cross academic disciplines, and include solving problems, communicating, using technology, working on teams, and making academic connections.

In investigating solid waste and 4Rs issues, students will call on knowledge and skills from the four major academic areas (science, social studies, language arts and math). This knowledge and these skills will be incorporated into a meaningful learning experience as they attempt to address a very real problem area in our society: the production, management and disposal of solid waste. Thus, students more easily make connections across academic areas as they formulate and propose real-life solutions supported by reason and evidence.

The middle school age is also an ideal time for students to work in groups and learn how to contribute as members of a working group. Many of the activities described in this guide can be accomplished using cooperative and collaborative grouping. Teachers are urged to use these activities in those fashions. The small group format further enhances the student level of discourse as students look for information, evaluate its veracity and usefulness, and struggle to express this information and their own ideas accurately and clearly in both written and spoken form. The use of current technologies, particularly

telecommunications and computer technology, will make available to students a wealth of information and expertise.

What else does this guide provide?

In addition to a listing of the Illinois Learning Standards, a number of other items of interest can be found in the Appendices. A Glossary of Terms (Appendix B) provides definitions for terms and acronyms which are commonly used in discussions of solid waste and 4Rs issues, but which might be unfamiliar to your students. Look for words in the text which are in **bold**, as an indication of which words you will find in the glossary.

Appendix C is a listing of books and articles for further reading and Appendix D provides a number of Internet addresses which might be helpful for further information on solid waste and 4Rs topics and issues. Finally, you will find a list of additional Illinois state government resources in Appendix E which might be of interest to you and your students as you pursue the very important issues related to solid waste, its management and disposal.

Matrix 1. Illinois Learning Standards Addressed by This Program

Objectives	English/ Language Arts								Math				Science						Social Science					
CHAPTER 1 OBJECTIVES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18						
1. Identify what municipal solid waste (MSW) is.													★											
2. Identify the three most common means of managing MSW.													★		★									
3. Summarize current trends in municipal solid waste disposal in Illinois and the US.													★		★									
4. Summarize the life cycle of a common product.													★		★									
5. Distinguish between renewable and non-renewable resources, giving examples of each.												★	★		★									
6. Compare the US and Illinois hierarchies for the management of solid waste.													★		★									
7. Describe how each of the following relates to integrated waste management: source reduction, recycling, landfilling, and incineration.													★		★									
8. Identify what the 4 Rs are.												★	★											
9. Explain why reduce precedes reuse and why reuse precedes recycle in the 4Rs.												★	★		★									
10. Identify 3 ways he/she can reduce his/her consumption.												★	★		★									
11. Identify 3 ways he/she can reuse products.												★	★		★									
12. Identify 5 items that he/she can recycle on a regular basis.													★											
13. Describe the progress Illinois has made regarding recycling since 1988.													★		★									
14. Synthesize an argument in favor of recycling based on the positive benefits it produces.													★		★									
15. Describe what is meant by the term: composting.												★												
16. Identify major components of a waste-to-energy incinerator.											★		★											
17. Identify positive and negative aspects of landfilling and incineration.											★		★											
18. Identify major components of a sanitary landfill. Explain why each of these is important in the landfill.												★	★		★									
19. Summarize Illinois state laws governing municipal solid waste management.													★		★	★								
CHAPTER 2 OBJECTIVES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18						
1. Explain the relationships that exist between events, problems, and issues.													★											
2. Provide examples of municipal solid waste problems that lead to issues.													★			★								
3. Define the following terms: problem, issue, belief, value.													★											

Matrix 1. Continued

Objectives	English/ Language Arts				Math					Science						Social Science		
4. Analyze given issues and identify the issue, the players, the players' positions, the players' beliefs, and the values that are associated with these positions and beliefs.					★								★	★		★		★
CHAPTER 3 OBJECTIVES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Identify a waste reduction or recycling issue.																★		
2. Research (using secondary sources of information) the scientific and social information critical to that issue.					★							★				★		
3. Analyze the important players involved in the issue in terms of their positions, beliefs, and values.					★									★		★		★
4. Generate suitable research questions focused on important elements of the issue.					★					★	★					★		
5. Prepare an appropriate research instrument which will answer the research questions.										★	★					★		
6. Select a valid sample from an identified population from which to collect data.										★	★					★		
7. Collect data from the identified sample using the research instrument.										★	★					★		
8. Generate appropriate charts and/or graphs for a visual presentation of the collected data.								★		★	★					★		
9. Correctly interpret the collected data by making suitable conclusions, inferences, and recommendations.					★			★		★	★							
CHAPTER 4 OBJECTIVES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Define and provide an example of the following methods of citizenship action: persuasion, consumerism, political action, physical intervention (ecomanagement).														★				
2. Identify the advantages of group action as compared to individual action.														★				
3. Review the information collected during the issue investigation (Chapter 3) and make recommendations regarding the solution of the issue based on that information.					★								★	★				
4. Analyze the proposed solution with respect to its consequences (ecological, economic, social, etc.).					★							★	★	★	★	★		★
5. Identify the most desirable solution in view of the solution analysis.					★								★	★				
6. Produce and defend a list of citizenship actions which might be appropriate for helping to bring about the desired solution.					★								★	★				
7. Select a particular citizenship action and working with a small group, evaluate the appropriateness of that action with respect to: the action's effectiveness; its legal, economic, ecological consequences, etc.; its potential for success based on the personal and group resources and skills.					★							★	★	★	★	★		★

Matrix 2. Illinois Learning Standards Addressed by this Program

OBJECTIVES	English Lang. Arts	Math	Science	Social Science
CHAPTER 1 OBJECTIVES				
1. Identify what municipal solid waste (MSW) is.			13B	
2. Identify the three most common means of managing MSW.			13B	15B, 15C, 15E
3. Summarize current trends in municipal solid waste disposal in Illinois and the US.			13B	15B, 15C, 15E
4. Summarize the life cycle of a common product.			13B	15B, 15C
5. Distinguish between renewable and non-renewable resources, giving examples of each.			12C, 13B	15B, 15C
6. Compare the US and Illinois hierarchies for the management of solid waste.			13B	15E, 16E
7. Describe how each of the following relates to integrated waste management: source reduction, recycling, landfilling, and incineration.			13B	15A, 15B, 15C, 15E
8. Identify what the 3Rs are.			12E, 13B	
9. Explain why reduce precedes reuse and why reuse precedes recycle in the 3Rs.			12E, 13B	15B
10. Identify 3 ways he/she can reduce his/her consumption.			12E, 13B	15B
11. Identify 3 ways he/she can reuse products.			12E, 13B	15B
12. Identify 5 items that he/she can recycle on a regular basis.			13B	
13. Describe the progress Illinois has made regarding recycling since 1988.			13B	15E
14. Synthesize an argument in favor of recycling based on the positive benefits it produces.			13B	15A, 15B, 15C, 15E
15. Describe what is meant by the term composting.			12 B, 12C	
16. Identify major components of a waste-to-energy incinerator.			11B, 13B	
17. Identify positive and negative aspects of landfilling and incineration.			11B, 13B	
18. Identify major components of a sanitary landfill. Explain why each of these is important in the landfill.			12C, 13B	15A, 15B, 15C, 15E
19. Summarize Illinois state laws governing municipal solid waste management.			13B	15E, 16E
CHAPTER 2 OBJECTIVES				
1. Explain the relationships that exist between events, problems, and issues.			13B	
2. Provide examples of municipal solid waste problems which lead to issues.			13B	16E
3. Define the following terms: problem, issue, belief, value.			13B	
4. Analyze given issues and identify the issue, the players, the players' positions, the players' beliefs, and the values that are associated with these positions and beliefs.			13B	5A, 5B, 14D, 16B, 16E, 18C

OBJECTIVES	English Lang. Arts	Math	Science	Social Science
CHAPTER 3 OBJECTIVES				
1. Identify a waste reduction or recycling issue.				16B, 16E
2. Research (using secondary sources of information) the scientific and social information critical to that issue.	5A, 5B		12A, 12B, 12C, 12D, 12E, 12F	16B, 16E
3. Analyze the important players involved in the issue in terms of their positions, beliefs, and values.	5A, 5B			14D, 16A, 16B, 16E, 18C
4. Generate suitable research questions focused on important elements of the issue.	5A	10B	11A	16A
5. Prepare an appropriate research instrument which will answer the research questions.		10B	11A	16A
6. Select a valid sample from an identified research population from which to collect data.		10B	11A	16A
7. Collect data from the identified sample using the research instrument.		10B	11A	16A
8. Generate appropriate charts and/or graphs for a visual presentation of the collected data.		6B, 6C, 6D, 8B, 10B	11A	16A
9. Correctly interpret the collected data by making suitable conclusions, inferences, and recommendations.	5B, 5C	8B, 10B	11A	
CHAPTER 4 OBJECTIVES				
1. Define and provide an example of the following methods of citizenship action: persuasion, consumerism, political action, physical intervention (ecomanagement).				14B, 14C, 14D
2. Identify the advantages of group action as compared to individual action.				14B, 14C, 14D
3. Review the information collected during the issue investigation (Chapter 3) and make recommendations regarding the solution of the issue based on that information.	5B, 5A, 5C		13B	14B, 14C
4. Analyze the proposed solution with respect to its consequences (ecological, economic, social, etc.).	5B, 5A		12A, 12B, 13B	14A, 14B, 14C, 14D, 15A, 15E, 16D, 16E, 18B
5. Identify the most desirable solution in view of the solution analysis.	5B, 5A		13B	14C
6. Produce and defend a list of citizenship actions which might be appropriate for helping to bring about the desired solution.	5B, 5A		13B	14C
7. Select a particular citizenship action, and working with a small group, evaluate the appropriateness of that action with respect to: the action's effectiveness; the action's legal, economic, ecological consequences, etc.; the action's potential for success based on the students' personal and group resources and skills.	5B, 5A		12A, 12B, 13B	14A, 14B, 14C, 14D, 15A, 15E, 16D, 16E, 18B

Table of Contents

MUNICIPAL SOLID WASTE AND THE 4Rs

CHAPTER 1

Municipal Solid Waste and the 4Rs in Illinois and the United States

Learner Objectives for Chapter 1

Upon completing the scientific background instruction related to municipal solid waste and the 4Rs the learner will be able to . . .

1. . . . Identify what municipal solid waste (MSW) is.
2. . . . Identify the three most common means of managing MSW.
3. . . . Summarize current trends in municipal solid waste disposal in Illinois and the US.
4. . . . Summarize the life cycle of a common product.
5. . . . Distinguish between renewable and non-renewable resources, giving examples of each.
6. . . . Compare the US and Illinois hierarchies for the management of solid waste.
7. . . . Describe how each of the following relates to integrated waste management: source reduction, recycling, landfilling, and incineration.
8. . . . Identify what the 4Rs are.
9. . . . Explain why reduce precedes reuse and why reuse precedes recycle in the 3Rs.
10. . . . Identify 3 ways he/she can reduce his/her consumption.
11. . . . Identify 3 ways he/she can reuse products.
12. . . . Identify 5 items that he/she can recycle on a regular basis.
13. . . . Describe the progress Illinois has made regarding recycling since 1988.
14. . . . Synthesize an argument in favor of recycling based on the positive benefits it produces.
15. . . . Describe what is meant by the term composting.
16. . . . Identify major components of a sanitary landfill. Explain why each of these is important in the landfill.
17. . . . Identify major components of a waste-to-energy incinerator.
18. . . . Identify positive and negative aspects of landfilling and incineration.
19. . . . Summarize Illinois state laws governing municipal solid waste management.

What is Municipal Solid Waste?

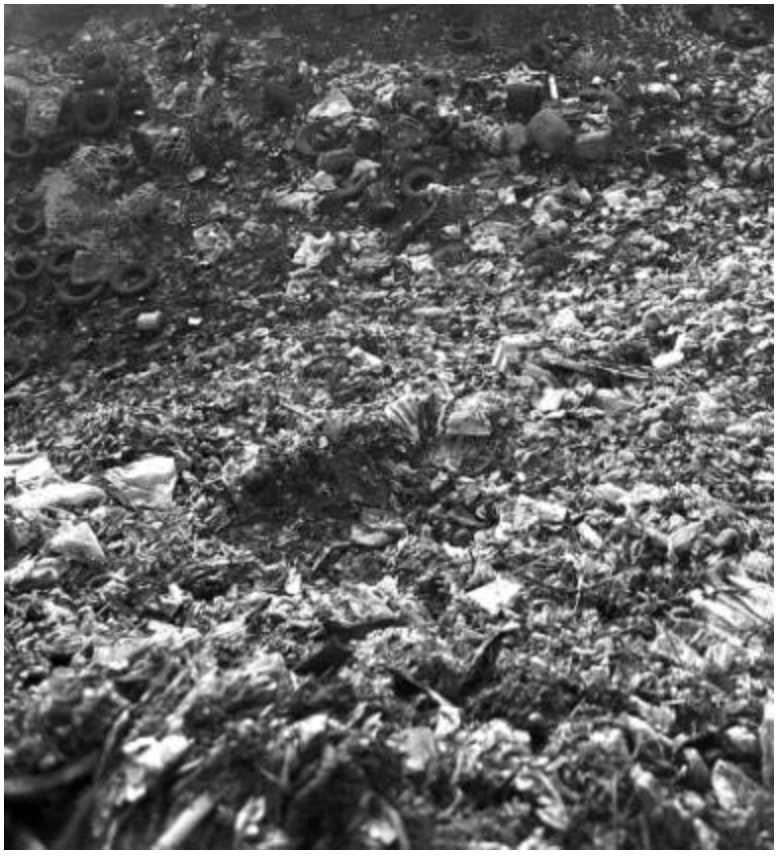
According to the United States Environmental Protection Agency (**US EPA**):

> ***Municipal solid waste** (**MSW**) includes wastes such as durable goods, non-durable goods, containers and **packaging**, food scraps, yard trimmings, and miscellaneous **inorganic** wastes from residential, commercial, institutional, and industrial sources. Examples of waste from these categories include appliances, automobile tires, newspapers, clothing, boxes, disposable tableware, office and classroom paper, wood pallets, and cafeteria wastes. MSW does not include wastes from other sources, such as construction and demolition debris, automobile bodies, municipal sludges, combustion ash, and industrial process wastes that might also be disposed in municipal waste landfills or incinerators.*

The Illinois Environmental Protection Agency (**IEPA**) defines municipal solid waste as:

> ***Garbage**, general household, institutional, and commercial waste, and construction and demolition debris.*

In Illinois, as well as the rest of the United States, people are generating increasing amounts of **solid waste**. The disposal of these wastes creates problems we must deal with as a society. These problems include how to **reduce** the volume of waste created, the cost of disposing of the waste, health concerns about **landfills** and **incinerators** used for waste disposal, the location of disposal facilities, and the depletion of natural resources.



This open dump is located in a very large, abandoned limestone quarry. Piles of solid waste like this are the result of not following the 4Rs - Reduce, Reuse, Recycle, Re-buy - nor constructing environmentally sound landfills. A variety of recyclable solid wastes can be identified in this photo including wood, paper, cardboard, plastic, rubber, and yard wastes.

Trends in Solid Waste

According to the US EPA, the people of the United States created 231.6 million tons of solid waste in 2000, an increase of 0.9 million tons in 1999. The recovery rate for recycling (including composting) was 30.1 percent in 2000, up from 28.1 percent in 1999.

The latest statistics reported by the IEPA (for 2001) indicate that Illinoisans created 16.0 million tons of garbage, up from 14.9 million tons in 2000. The data also shows that 74 percent of Illinois' **trash** was put in landfills, about 26 percent was **recycled** (including **composting**). Both national and state trends indicate that growing percentages of solid waste are being recycled.

The US EPA has established an **integrated waste management** hierarchy for the management of municipal solid waste. The components are:

- **Source reduction** (including reuse of products);
- Recycling (including composting);
- Waste combustion (preferably with **energy** recovery); and
- Landfilling.

A similar waste management hierarchy for Illinois was established by the 1986 Solid Waste Management Act:

- Volume reduction at the source;
- Recycling and reuse;
- Combustion with energy recovery;
- Combustion for volume reduction; and
- Disposal in landfill facilities.

Waste: Only the Last Link in a Chain

This teacher's manual is concerned with municipal solid waste. However, to understand solid waste we must realize that it is only the last link in a long chain of events. Waste is the last stage in what is sometimes referred to as a **product life cycle**. Each piece of waste we produce is first a useful item. Its impact on the **environment** as waste is only a small portion of its total life and of its total impact.

The life cycle of a product typically begins with the extraction or gathering of the raw materials that go into the product. The raw materials are then transported to a location where they are processed. Next, the processed materials are manufactured into a finished product. That product is then transported to a point of sale. Then it is sold, taken home, and used. Finally, once the usefulness of the product is exhausted, it becomes waste by being discarded. The discarded product is picked up and typically landfilled, incinerated, or recycled in some way.

Bauxite Mined

Land disrupted; fossil fuels consumed; air pollution created

Bauxite Transported

Fossil fuels consumed; air pollution produced.

New Aluminum Produced

Electricity consumed; air, water pollution produced; energy consumption equals 1% of nation's total energy; energy consumed = 7 kwh/lb.

Aluminum Transported

Fossil fuels consumed; air pollution produced.

Aluminum Fabricated Can Produced

Fossil fuels consumed; air pollution produced.

Can Transported

Fossil fuels consumed; air pollution produced.

Can Filled

Fossil fuels consumed; air pollution produced.

Beverage Transported

Fossil fuels consumed; air pollution produced.

Beverage Sold

Electricity consumed; air, water pollution produced.

Beverage Stored, Consumed

Electricity consumed; air, water pollution produced.

Can Thrown Away

Fossil fuels consumed transporting trash, operating landfill ; air pollution produced.

Landfill

No resources recovered; landscape disrupted; taxes spent.

Can Recycled

Fossil fuels consumed; air pollution produced; Energy comsumption equals 5% of the energy needed for new aluminum (0.35 kwh/pound).

Aluminum Produced

Fossil fuels consumed; air pollution produced.

The Life Cycle of an Aluminum Can: The Environmental Impact of Something Simple

At each step in this life cycle there are numerous interactions with the environment. Interactions occur when one thing causes a change in another. Resources such as petroleum, minerals, and trees are removed from the environment. Energy is consumed. Land may be made unusable as natural habitat. Water and air are polluted. Such interactions with the environment are the inevitable consequence of life in an industrial society. If we want to continue to live in the way we do, we will continue to interact with the environment in ways that disrupt and damage it. At the same time, however, we can consider the environmental impacts of our actions and make informed choices about them. There are things we can choose to do that serve to minimize the harm we do to our environment. For example, by reducing unnecessary consumption of products or by reusing products, we reduce the extraction of **natural resources** and cut down on **pollution** caused by the manufacturing process. Further, by recycling products rather than throwing them away we can similarly reduce resource usage and pollution.

The natural environment is a complex system. There are many smaller systems and components in it. Each of these components and subsystems interacts in many ways with the parts of the system. **Nutrients**, water, and energy constantly flow through the environment. The various organisms and systems within the environment are interdependent on one another.

When humans interact with the environment we can disrupt the existing natural systems. Human actions are themselves, more often than not, parts of complex systems. Even a simple item like a **plastic** grocery bag is a product of a complex life cycle. To produce the bag, oil must be explored for, often using seismic testing. An oil well must be dug. Pipelines must be laid and oil must be pumped to a refinery. The crude oil must be refined, and the products synthesized into plastic. Plastic must be fabricated into a bag and shipped to a grocery store. Then a **consumer** buys food and carries it home in the bag.

At this point the consumer has a choice. The bag can be thrown in the garbage or it can be reused. If it is thrown away, then it becomes part of a landfill and remains intact forever for all practical purposes. Someone must pay for the land for the landfill. Someone must pay for the operation of the landfill. On the other hand, if the bag is reused a whole new set of interactions occur. The reuse of the bag not only reduces the need for landfilling and all the economic and social costs associated with that, it also reduces the need for the production of additional bags. Done on a large scale, the reuse of plastic bags can reduce the need for oil exploration, drilling, refining, plastic manufacturing and fabrication and transportation. These reductions, in turn, save natural resources such as water and sources of energy (petroleum, natural gas, coal) that are required at each step of the product's life cycle. Not only does reusing the bag reduce landfill use, it reduces all the interactions involved in the life cycle of the bag.

Types of Resources

There are a number of ways of classifying natural resources. One classification system is to consider whether or not they are renewable. **Renewable resources** are those that can be renewed or replaced in a reasonable length of time. Renewable resources include trees and animals. If we harvest trees in a forest, we can plant new trees to replace them. If we kill animals for food, we can raise new ones. Renewable resources are renewed by natural processes. Even renewable resources, however, are not necessarily infinitely renewable. If we use the resources to such an extent that we seriously disrupt or destroy the natural processes that renew the resources, then we may lose the resources altogether.

Non-renewable resources are things that for all practical purposes cannot be replaced. Once they are used, they are gone for good. Minerals are a non-renewable resource. Petroleum and other fossil fuels are non-renewable. Anything that is made from minerals or fossil fuels consumes non-renewable resources. **Iron**, **steel**, **aluminum**, copper, all other metals, plastics, synthetic fibers, synthetic pharmaceuticals, and glass are examples of materials or products that come from non-renewable resources. These materials do not disappear after they are used. They all continue to exist somewhere, e.g., in buildings, as **litter**, or in landfills.

Reducing our use of waste that was derived from non-renewable resources can help to slow the rate at which non-renewable resources are consumed. Reusing and recycling that waste can also reduce the demand for non-renewable resources. In addition, when we re-buy recycled content items, we create a market to sustain recycling efforts.

The need to conserve natural resources is a concept that is sometimes hard for us to grasp. In earlier times humans viewed the vast wildernesses and oceans of the world and conceived of them as virtually limitless. We now know that is not the case. Many of the world's mineral and energy resources are becoming quite taxed. Within the lifetime of today's students (and perhaps today's teachers as well) petroleum as a usable energy resource and as the raw material for drugs, plastics, fibers and other products may become a thing of the past. When we can reduce, reuse, and recycle waste derived from these resources, we are actually protecting our standard of living and way of life.

The 4Rs: Reduce, Reuse, Recycle, Re-buy

As was just mentioned, in order to lessen our impact on natural resource utilization, we can 1. Reduce the number of products we consume, 2. Reuse products over and over again, 3. Recycle products rather than throwing them away, and 4. Re-buy recycled content products. Both the **US EPA** and the Illinois Department of Commerce and Economic Opportunity (DCEO) endorse this four-pronged plan to manage solid waste. It's known as the 4Rs: Reduce, Reuse, Recycle, Re-buy. The 4Rs are presented in the order that consumers are encouraged to help solve the solid waste problem. By reducing consumption we eliminate the use of products and therefore also eliminate the utilization of natural resources. By reusing products we reuse the natural resources from which the products were manufactured and therefore do not cause consumption of additional natural resources. Although recycling items into new products requires the use of some natural resources (such as energy in the form of petroleum), the **recycled products**' impact on the environment is less than if natural resources were utilized to make those same products from scratch. For example, recycling aluminum takes only five percent of the energy required to make aluminum from bauxite ore. Finally, when consumers re-buy (purchase products manufactured with recycled content), they contribute to the demand for recycled content products, thus increasing manufacturers' need for recycled commodities.

Reduce

The best way to keep solid waste out of the **waste stream** is to reduce it at its source, i.e., **source reduction**. What you don't use, you can't throw out. Therefore, source reduction conserves natural resources, results in less pollution, and saves money. There are many ways we can aid in source reduction. A number of them are listed below:

See Activity 1: Reduce Your Use

- Avoid using disposables
- Purchase goods that use less packaging. Packaging materials make up more than 30 percent of all consumer waste.
- Buy only what you need.
- Buy in bulk to reduce the amount of packaging.
- Share or rent items which are used infrequently. These include carpet cleaners, floor buffers, and garden tillers.
- Buy or make alternative products that don't contain toxic or **hazardous** substances, for example:

  Make an all-purpose cleaner from baking soda and water.

  Use a vinegar and water mixture to clean floors and walls as well as windows.

  Open the windows instead of using air fresheners.

  Mix one teaspoon of olive oil with the juice of one lemon in one teaspoon of water to use in place of furniture polish.
- Use the telephone or the Internet to search for information rather than using a vehicle to drive from place to place.
- Dry clothes on a clothesline. If you want to make the line-dried clothes softer, tumble them in a dryer for a short time without heat.
- Insulate your attic to reduce energy needed for heating and cooling.
- Buy products such as concentrated laundry detergent that are sold in smaller containers than non-concentrated products.
- Purchase energy efficient appliances when old ones wear out.
- Buy products made from recycled materials.
- Compost your food waste and yardwaste.
- Walk or ride a bike rather than driving.
- Take public transportation rather than driving.

- Use a car pool whenever possible.
- Use both sides of a piece of paper.
- Share magazines with friends, family and coworkers.
- Use bulletin boards to post memos instead of distributing copies.
- Edit, send and store documents electronically rather than use printed copies.
- Contact companies from which you receive unwanted advertising or catalogs and ask them to take you off their mailing lists.
- Contact companies from which you do wish to receive advertising. Ask them not to give your name to other companies.
- To be removed from national mailing lists you can contact:

  Direct Marketing Association
  Mail Preference Service
  P. O. Box 9008
  Farmington, NY 11735-9008
  http://www.the-dma.org/consumers/offmailinglist/html

Reuse

See Activity 2: Reuse It!

By reusing products rather than throwing them away, we keep these items out of the waste stream and eliminate the need to send them to a landfill or incinerator. When we reuse a product for its intended purpose, such as reusing a paper grocery bag, we reduce the need for using natural resources (trees) to make another bag. When we reuse an item for a different purpose than originally intended such as using a plastic peanut butter jar to hold nails or buttons, we eliminate the need to buy new containers for nails or buttons. In any event, by reusing the bag or the jar we have kept these items from entering the waste stream.

There are many ways, through reuse, that we can help reduce the number of items that become part of the waste stream. Here are a few of them:

- Reuse durable mugs, glasses, dishware and silverware rather than eating from disposable paper or plastic containers.
- Reuse a cloth sack to carry your groceries each time you shop.
- Reuse old tires for swings or playground obstacle courses.
- Go to the library to check out books rather than buying new ones. Also, many libraries have free paperback book exchanges. If your library does not have a book exchange, encourage it to start one.
- Have a yard or garage sale to sell items that you no longer want. If you don't want to sell these things, donate them to an organization or group that can reuse or sell them.
- Buy reusable products such as rechargeable batteries.
- Make pads of notepaper from used envelopes and the backs of pieces of used paper.
- Encourage businesses to donate their old computers for use in school classrooms.

- Take your lunch in reusable plastic containers rather than using plastic wrapping.
- Save bubble wrap and packing peanuts that you receive and reuse them when you send a package. Donate extra bubble wrap and peanuts to retail postal and shipping centers.
- Use slates instead of paper to do classroom exercises or in place of scatch paper.
- Refill printer and copier cartridges.

Recycle

***See Activity 3: Is It Recyclable*?**

Another method of managing waste that has attracted a great deal of attention in the past 20 years is recycling. Recycling accounted for 30.1 percent of the municipal solid waste processed in the US in 2000. In 2001, it accounted for 26 percent (including composting) of the municipal solid waste processed in Illinois. When objects are recycled, the materials they were made from are reused. This conserves natural resources. Generally speaking, using recycled materials to make new products is cheaper and requires less energy than making new materials. Also, recycling reduces pollution compared to making products from raw materials, because some steps in the manufacturing process are eliminated. In addition, recycling reduces the amount of land needed for landfills, and recycling benefits the economy by creating jobs for those who collect, process and manufacture the materials. Recycling is sometimes referred to as **resource recovery**.

Broadly speaking, there are two approaches to resource recovery: **centralized resource recovery** and **source separated recycling**. In a centralized system, the **recyclable** materials are collected mixed and are then sent to a central location called an **MRF**, a **materials recovery** (or **reclamation** or **recycling**) **facility,** to be sorted and processed. If the recyclables arrive mixed with non-recyclable solid wastes, the MRF is referred to as a **dirty MRF**, and the recyclables have to be separated from the non-recyclables. In either case, the recyclable materials have to be separated into like materials such as steel, aluminum, glass, plastic, and paper.

In **source separation** recycling, the user separates the materials that are going to be recycled at the time of disposal. Materials are sorted into different bins, and the bins are set out (often at curbside) for pickup. Compartmentalized trucks are then used to collect the materials and deliver the recyclables to recycling processors where contamination is removed and the separated materials are prepared for shipment to market. Facilities which process source separated recyclables may also known as a MRF.

In both resource recovery approaches, the sorted recyclables end up at a recycling facility or **market** where they are used to produce new products. Of course, the processes used to turn different recyclable materials into new recycled products are themselves different.

Aluminum: Aluminum, which is made from bauxite ore, requires approximately four pounds of ore to make one pound of aluminum. When recycled aluminum is used to make aluminum cans, the process requires only 5 percent as much energy as it takes to make the same can from the bauxite ore - a savings of 95 percent of the energy. Almost all aluminum items can be recycled including foil, pans, house siding, and beverage cans.

When aluminum cans are brought to a MRF, they are crushed to reduce volume and then baled. From the MRF the bales are shipped to plants where they are shredded, melted, and formed into aluminum bars. The bars go to another facility where they are rolled into thin sheets. At a container factory the sheets of aluminum are cut and formed into cans. Of the one hundred billion (100,000,000,000) aluminum beverage cans used each year in the US, about sixty-five billion (65,000,000,000) are subsequently recycled.

Steel: Steel is easily separated for recycling because of its magnetic properties and is one of the most recycled of materials. Recycled steel is made into new steel by either of two processes. One method involves mixing molten recycled steel with new steel in a furnace. Cans, autos, and appliances such as refrigerators are made from the sheets of steel produced from this process. The other process uses 100 percent recycled steel. Recycled steel is put in a furnace and melted using an electrical process. The molten steel is formed into thick steel products such as beams and reinforcing bars.

Household steel food cans require an additional processing step due to the thin coating of tin used to prevent corrosion. Detinning mills remove and recover the valuable tin before the steel is used to manufacture new products. In 1998, the US recycled almost 18 billion steel cans and recovered 2.7 million tons of steel through recycling efforts. Over 50 percent of the steel cans used each year in the US are made from recycled steel.

Plastics: There are seven types (or **resins**) of plastics that can be recycled and they are numbered from one to seven. Two of the most common types of recycled plastics are No. 1 - polyethylene teraphthalate - PETE for short and No. 2 - high-density polyethylene - HDPE for short. When collected plastic is recycled, it is separated by color and resin type, cleaned, shredded, and melted into pellets. The pellets are subsequently remelted and formed into a final product.

Recycled PETE plastic resin, which comes from soft drink bottles, can be made into clothing, fiberfill for jacket and coat insulation, carpeting, and containers. Recycled HDPE resin which comes from milk jugs and laundry detergent bottles can be recycled into plastic fencing, toys, crates, and containers. Different mixtures of plastic types may be recycled into garbage cans, park benches, plastic lumber, and even railroad ties. Recycled PETE plastic can be made into thread which is woven into cloth and subsequently made into products such as T-shirts and tote bags. Although used plastic is recyclable, in the US only about 5 percent is actually recycled. As a result, plastic makes up about 10 percent of the waste stream's weight and 20 percent of its volume.

The following are intended to be used on plastic containers to identify their composition and to aid consumers in determining which containers may be recycled in local programs. They are not intended to indicate either recyclability or recycled content.

For further details refer to the Federal Trade Commission's "Part 260 --Guidelines for the Use of Environmental Marketing Claims".

Glass: In most cases scrap glass has to be sorted into colors – clear (flint), brown (amber), and green (emerald) - before it can be recycled into new products. After sorting, the glass is crushed into **cullet**, melted in a furnace to a liquid state, and then molded into new products such as glass bottles and jars. Recycled glass is also used to make ceramic tiles, fiberglass, reflective paint, and beads. Further, recycled glass is used in sandblasting. Interestingly, cullet is mixed with asphalt to make highway-paving material called glassphalt. Sandblasting, fiberglass and glassphalt are examples of markets that can use unsorted glass cullet. Nearly 40 percent of the glass used in the US is recycled.

Paper: Nearly all types of paper products can be recycled. Cardboard, newsprint, and high quality paper, e.g., notebook paper, stationery, computer paper, and envelopes, are among the recyclable paper items. Of these, newsprint and cardboard are the most commonly recycled paper products. Paper is recycled by shredding it and mixing it with hot water. This mixture is then turned into a pulp by blending machines. Inks are then removed with detergents in a flotation process. Chemicals and injected air cause the ink particles to float to the surface where they can be removed. The whiteness of the paper pulp can be further improved with chlorine or peroxide bleaching agents. Through a screening process, the water is removed from the pulp. The fiber that remains is pressed through rollers and then dried, resulting in a recycled paper product.

Paper products including cardboard, paperboard (packaging such as cereal and cake mix boxes), newsprint, and high quality paper make up 40 percent of the waste stream. Paper products are the largest single component in landfills. Every 2,000 pounds of paper that is recycled saves about 50 cubic feet of landfill space and prevents 17 pulpwood trees from becoming paper. Moreover, for every ton of paper that is recycled, about 16 fewer pounds of air **pollutants** are released into the **atmosphere**.

Composting: **Composting** is a special form of recycling. In composting, perishable products such as yard and food waste are decomposed by **aerobic bacteria,** molds and fungi. These are microorganisms that use the oxygen in the air to consume nutrients. Larger organisms, such as worms, crickets, beetles, etc., can also play a role in composting. Yard trimmings make up 13 percent and food waste suitable for composting make up 4 percent portion of municipal solid waste in the US. Yardwaste is banned from landfilling in Illinois.

See the Vermiculture Project (following the Activity Section)

When **biodegradable** materials are decomposed by aerobic organisms a nutrient-rich **humus** or **compost** is produced. This material can be used as fertilizer in lawns and gardens. Home composting is carried out in piles or bins. The yard and vegetable food waste are piled in the bin. The pile is moistened as needed and mixed from time to time. The moistening hastens the **decomposition** process. The mixing or turning insures that the bacteria will receive an adequate supply of oxygen. As long as the pile continues to decompose aerobically (in the presence of oxygen), no strong odor is formed.

Composting can also be carried out on a larger scale. In large-scale composting, the waste must first be examined to remove items that are not suitable for decomposition. Bulky components, such as branches, are typically put through a grinder to reduce the size, simplify handling and speed decomposition. The waste is then placed on the ground in long piles (windrows) or in mechanical systems (also called in-vessel systems). Intensive in-vessel processing of compostable vegetable matter can create humus in as quickly as three weeks. Windrows generally take longer. As with backyard composting, the piles are kept moist and aerated. This resulting compost has a total nitrogen, phosphorous, and potassium content of from 1 to 3 percent. The compost can then be made available to local residents for lawn and garden use or moved to market as a salable garden product. In 1998, there were 47 active commercial yardwaste composting facilities in Illinois. Food waste composting is not yet widely practiced commercially.

Other Recycling Possibilities: Curbside pick-up programs are an easy way to participate in recycling and there are about 9,000 of these in the US with more than 400 in Illinois. If a pick-up program is not available, recyclables can be taken to a recycling drop-off center. Several more recycling possibilities follow:

- Recycle worn out appliances, such as refrigerators, stoves, washers etc., after replacing them with energy-efficient new ones. Most scrap metal processors or salvage yards will accept used appliances and some may even provide pick-up service. Illinois law requires the removal of CFCs and other hazardous components of appliances before they can be recycled or landfilled.
- Setup your own compost bin to recycle grass, yard trimmings, and green garbage. "Green garbage" refers to plant and vegetable derived food waste such as banana peels and potato skins. Food wastes containing meat and other animal products are not recommended for home composting.
- Recycle grass by letting it decompose into the lawn, where it returns nutrients to the soil.

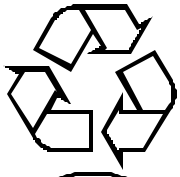
- Recycle used motor oil. Forty-five percent of vehicle owners change their own oil, which amounts to 120,000,000 gallons per year in the US. After draining the oil from the engine and the oil filter, take it to an auto service center that recycles oil. Some recycling centers can recycle the oil filter. Used motor oil contains toxic substances such as lead and benzene. The oil from one oil change, if disposed of improperly, can pollute up to 1,000,000 gallons of water. Liquid used motor oil is banned from Illinois landfills.
- Make an extra effort to recycle aluminum, glass and plastic. These three substances virtually do not break down buried in landfills and so will be with us for a long, long time.
- Always be sure to recycle products such as car batteries, paint, solvents, antifreeze and other products that contain **toxic materials**. Never dispose of these materials in your garbage. Check with your local government solid waste department to find out how to dispose of these items.

Re-Buy

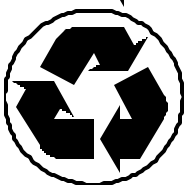
In terms of the management of solid waste, recycling is second in the hierarchies of both the US and Illinois governments. However, for recycling to be effective in **solid waste management**, much more is involved than sorting recyclable materials and putting them out for curbside collection or taking them to a drop-off center. The processing and manufacturing of recyclables into salable items and the subsequent purchase of these items is necessary to "close the loop," so to speak. The three circling arrows of the familiar recycling symbol represent these three stages of recycling: collection, processing and manufacturing.

Manufacturing recycled waste into products is certainly an important step in the recycling process, but to close the loop consumers must purchase these products. Most items made from recycled materials are labeled as such (See chart below). Also, when a product is packaged in a container made from recycled materials, the container is labeled as being recycled. However, there is a difference between a **recycled product** and a **recyclable product.** A recycled product is one that is made from recycled material while a recyclable product is one that can be recovered and recycled after being used.

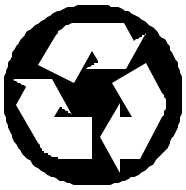
Generally Accepted Use of Recycling Symbols



Product or package is generally recyclable.



Product or package contains recycled content.



Product or package is made from 100% recycled materials (Used primarily for paper products).

A thriving industry exists which manufactures recycled solid waste into commercial products. In addition to some of the more common items made of recycled materials such as newsprint, stationery, jars, bottles, and cans, there are a large number of less well known products manufactured from recycled waste materials. These include: animal bedding, CD jewel boxes, basketball backboards, drywall, car bumpers and parts, drainage pipe, fencing, laser printer cartridges, playground surfacing, speed bumps, and carpet to name a few. In Illinois alone, at least 130 companies manufacture and offer for sale products made from recycled materials. In 2001, at least 425 Illinois companies manufactured and offered for sale products made from recycled materials.

Buying products in recycled packaging and purchasing recycled products has many benefits. DCCA's Bureau of Energy and Recycling points out in its pamphlet, *Why Buy Recycled?,* that when you buy recycled products, you . . .

1. Benefit the economy by creating jobs. For example, over 56,000 people are employed in recycling and reuse industries in Illinois.
2. Reduce waste and pollution.
3. Save landfill space.
4. Conserve resources.
5. Minimize energy usage.
6. Sustain demand for recyclables that people generate.
7. Create a **conservation** ethic, which ensures a positive future for families and communities.

Landfills and Incinerators

Solid waste that is not reused or recycled has to go somewhere. The U.S. EPA's *Municipal Solid Waste in the United States: 2000 Facts & Figures* says that nationwide 55.3 percent of solid waste was landfilled, 30.1 percent was recycled or composted and 33.7 percent was incinerated. In Illinois garbage is no longer incinerated.

Landfills

Open dumping and burning of trash were once common practices in the US. Of the approximately 250 million tons of waste generated in 1969, only about 190 million tons were collected. The remainder was discarded in vacant lots and backyards and along roadways. That began to change in the 1970s. The Resource Conservation and Recovery Act of 1976 empowered the US EPA to regulate and design the operation of landfills. In Illinois, the Pollution Control Board is responsible for establishing landfill regulations and the IEPA is responsible for the enforcement of the regulations. Since 1981, regional pollution control facilities such as landfills must obtain approval of the local government as well as the IEPA for expansion or construction. Currently, regulations in Illinois, which were passed in 1990, cover the siting, permitting, design, construction, quality assurance, landfill operation, monitoring, financial assurance, closure, and post-closure care of new landfills.

See Activity 4: Construct a Model Landfill

At present, landfilling is the most common method of disposing of municipal solid waste. Modern landfills are referred to as **sanitary landfills**. A sanitary landfill is a huge pit in the ground with a liner along the sides and bottom that prevents waste from coming in contact with the earth. The liner prevents contaminated water from seeping into the earth and eventually polluting surface water, ground water and drinking water wells. The liner has five layers. The bottom layer is made of two or more feet of clay that has been compressed so that it is very compact. The layer above the clay is made of thick, flexible, waterproof HDPE, EDPM or other plastic. Above this layer is a drainage layer of one foot of gravel. Contaminated water and other liquids (**leachate**), which **percolate** down through the upper two landfill layers, collect in the gravel layer.

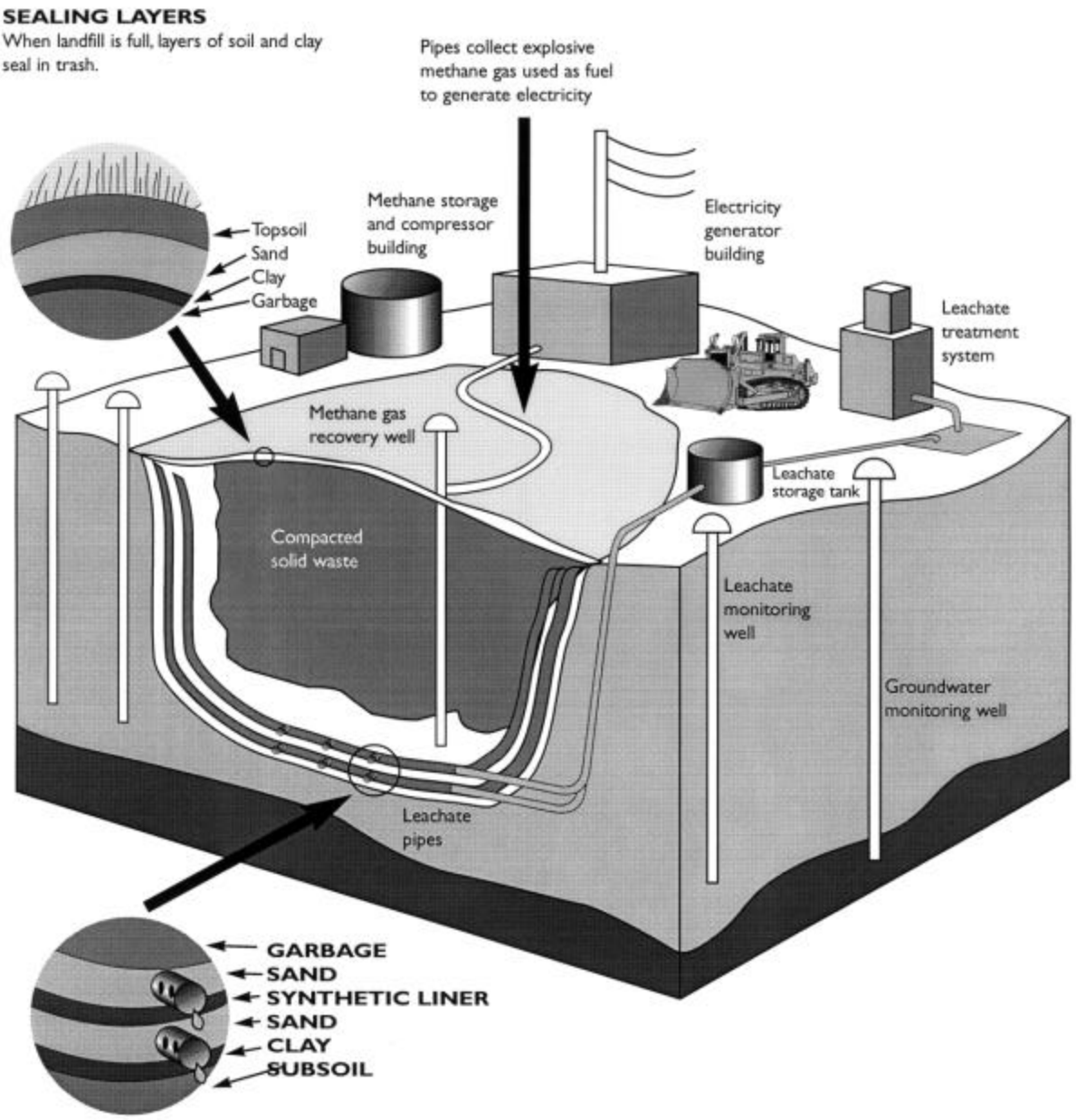
Pipes run through the gravel layer will collect the leachate. The leachate is drained from the landfill through the pipes and then is filtered. On top of the gravel is a layer of geotextile fabric, which helps protect the pipes. The top layer, which is above the geotextile fabric, is one foot of compacted soil. Leak detectors positioned below the liner and **groundwater** monitoring wells located around the landfill help to assure that the liner and the leachate pipe system are functioning properly.

As solid waste is brought to a landfill, it is spread in thin layers and compacted by bulldozers before another layer is spread and compacted. At the end of each day, the waste is covered with a thin layer of soil or other material to keep out vermin and prevent windblown debris. When the layers of compacted garbage are ten feet high, they are covered with about six inches of soil, which is compacted into place. This is called a **cell**. After the landfill becomes completely full, it is covered with more layers of clay, plastic, and soil and then planted with grasses and trees as well as other vegetation.

The waste in landfills decomposes anaerobically. **Anaerobic** decomposition is carried on by bacteria in the absence of oxygen. Among the gaseous products of anaerobic decomposition are **methane**, hydrogen sulfide and other volatile organic compounds (VOCs). Methane is the simplest **hydrocarbon**, and is the main component of natural gas. Methane can be a potential hazard because it is explosive at high temperatures. Hydrogen sulfide is both a hazard and a nuisance. This gas is poisonous, contributes to acid rain, and has the foul odor of rotten eggs.

Problems with landfills can be avoided by carefully constructing the liner so that leachate cannot escape from the landfill, polluting groundwater and surface water. Proper planning and siting of a landfill can prevent it from coming into contact with upland drainage, high groundwater levels, and flooding. Also, gases such as methane and hydrogen sulfide can be vented out of the landfill through vent pipes. Generally, the methane is burned off as it escapes the landfill. However, many landfills remove the hydrogen sulfide with vent pipe **scrubbers** and recover the methane to be used as fuel rather than being burned off and wasted.

Modern Sanitary Landfill



Clay and plastic lining to prevent leaks: pipes collect leachate from bottom of landfill.

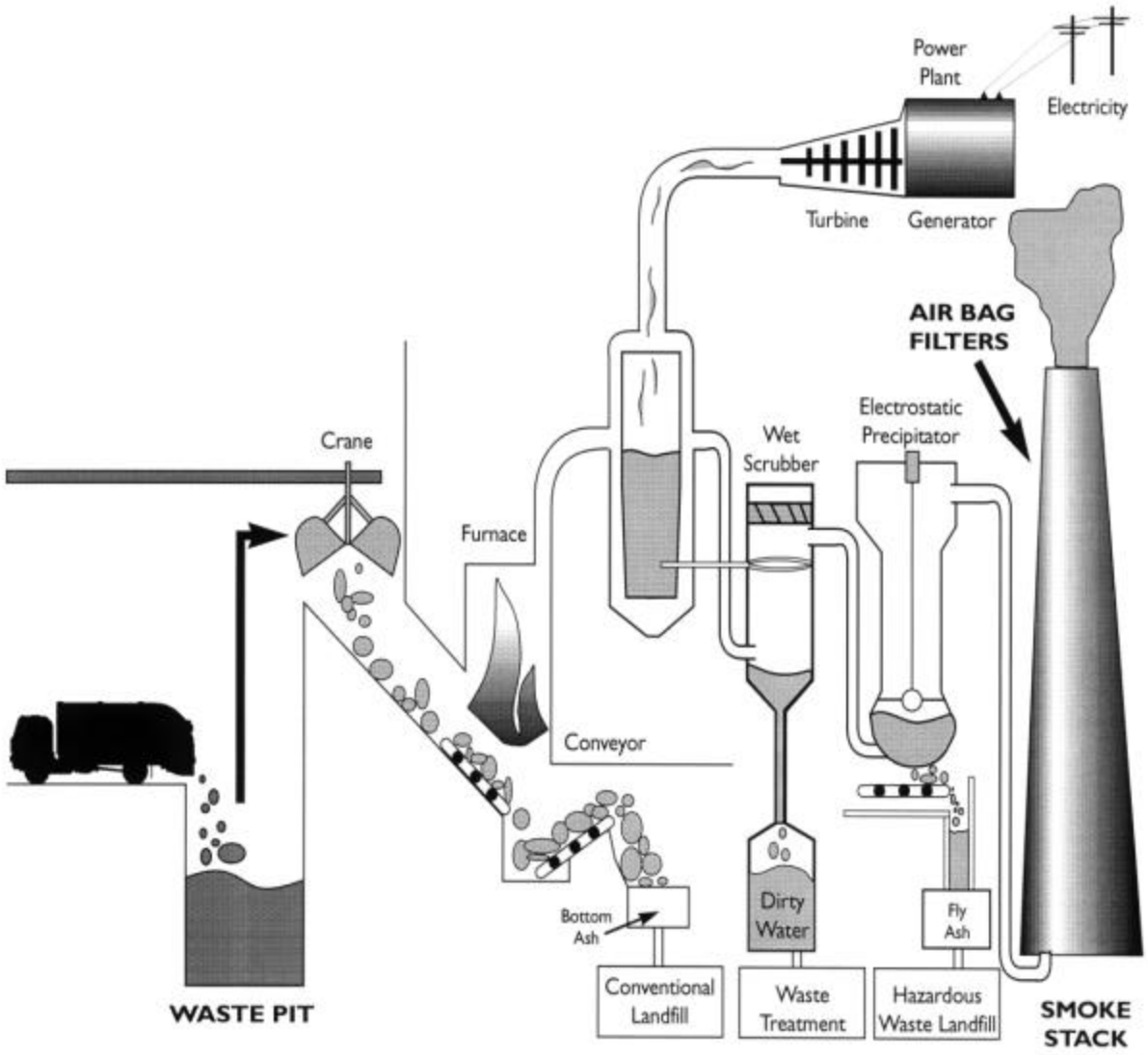
Incinerators

Incineration or combustion is another method for disposing of solid waste. In this method, solids are loaded onto conveyor belt-like grates and burned at high temperatures in burning chambers. The solids and gases in the smoke are burned in secondary chambers. Wet scrubbers, electrostatic precipitators, and filters clean emissions from the incinerator. The waste collected from the smoke and the **fly ash** left from the incineration process (about 30 percent of the weight of the pre-burned trash) is then landfilled.

Advocates of incineration point out that incinerators provide an efficient method of waste reduction that reduces the amount of solid waste in need of landfilling. Additionally, incinerators can be a source of energy. The heat released by the combustion of waste can be used for running the incinerator or for generating electrical power. This is called **waste-to-energy** incineration.

Opponents of incineration believe that incinerators are expensive not only to build but to operate as well. Another objection is that incinerators hinder reuse and recycling efforts, because they need to burn a large amount of potentially recyclable paper and plastics in order to operate economically. One other argument against incinerators is that even with modern anti-pollution technology, small amounts of pollutants such as **hydrochloric acid**, **dioxins** and **furans** as well as lead, cadmium, and mercury are released into the atmosphere during combustion. Also, as with burning nearly any material, large amounts of the greenhouse gas, carbon dioxide, is produced.

Waste-to-Energy Incinerator



Municipal Solid Waste in Illinois

Illinois Laws Affecting Solid Waste Management

Four primary laws address the topics of solid waste reduction and recycling in Illinois:

- **The Natural Resources Act**
- **The Solid Waste Management Act**
- **The Solid Waste Planning and Recycling Act**
- **The Illinois Environmental Protection Act**

The state of Illinois does not have one all-encompassing law that deals with solid waste management. Although many individual legislative acts focus on the management of solid waste, there are four primary laws that address the topics of solid waste reduction and recycling. These are the Natural Resources Act, the Solid Waste Management Act, the Solid Waste Planning and Recycling Act, and the Illinois Environmental Protection Act. In June of 1995, the Illinois Department of Commerce and Economic Opportunity (DCEO) became the state agency in charge of the waste reduction and recycling programs, which are governed by these laws.

The Solid Waste Management Act (SWMAct) set forth a hierarchy for dealing with solid waste management. The 3Rs - Reduce, Reuse, Recycle - come first, followed by incineration with energy recovery and incineration for volume reduction, and then landfilling. Under the SWMAct, DCEO provides both technical and financial assistance to implement waste reduction, recycling and recycling education projects. Two other of the SWMAct requirements are:

1. The Illinois Department of Central Management Services is required to purchase increasing amounts of paper and paper products that are made from recycled paper, and

2. State-supported colleges and universities are required to develop waste reduction and recycling programs.

In addition, under the Solid Waste Planning and Recycling Act (SWP&RAct), each county in Illinois is required to develop its own solid waste management plan. Plans for Chicago and counties with populations over 100,000 had to be adopted by March 1, 1991. Counties with less than 100,000 residents were required to adopt their plans by March 1, 1995. The SWP&RAct mandated that each county's waste management plan include goals of recycling 15 percent of solid waste within three years and 25 percent within five years. These waste management plans must be updated every five years.

The Natural Resources Act reorganized the state agencies responsible for managing the state's natural resources. This act gave DCEO the responsibility to promote solid waste management through recycling and waste reduction. Included in this law are requirements to develop instructional materials on recycling and waste reduction for use in the state's schools.

The Environmental Protection Act (EPAct) puts forth the environmental regulations for the state. The EPAct regulates the disposal of solid waste. Among the regulations included in this act are those for issuing permits for landfills, compost sites, and **transfer stations**. To provide funding for DCEO's and IEPA's solid waste management activities, the EPAct authorizes state and local governments to

place surcharges on **tipping fees** at state landfills. Additional funds for are provided by the EPAct's imposition of a one dollar ($1.00) fee on each tire sold at retail in the state. A substantial portion of this tax is used to eliminate stockpiles of used tires and to aid used tire recycling programs and used tire remanufacturing. Also, this act disallows the following items from being disposed of in Illinois landfills: yard waste, auto batteries, whole used tires, large appliances such as refrigerators that have not had certain hazardous components removed, and liquid used motor oil.

Solid Waste Management in Illinois

In 2001 Illinoisans handled 16.0 million tons (16,000,000 tons) of solid waste. Of this amount, 1.4 million tons of garbage were imported into Illinois from 11 other states.. Illinois also exports waste to other states. The amount exported to other states is not known precisely, but is estimated to be about the same as imports. What happened to this solid waste? In 2001, only about 26 percent was recycled and composted and 74 percent was landfilled. The remainder was incinerated.

See Activity 5: Student's Home MSW Inventory Worksheet

Landfills: For purposes of data collection regarding solid waste management in Illinois, the state is divided into seven regions: Region One - Northwestern Illinois; Region Two - Chicago Metropolitan Area; Region Three - Peoria/Quad Cities; Region Four - East Central Illinois; Region Five - West Central Illinois; Region Six - Metropolitan East St. Louis; and Region Seven - Southern Illinois.

The table below presents data relating to landfilling in Illinois, region by region, for 2001 as reported by the IEPA in *Nonhazardous Solid Waste Management and Landfill Capacity In Illinois: 2002.* By the end of 2001, Illinois had 52 landfills that were receiving solid waste,
down one from 2000. The amount of waste landfilled has dipped in the early to mid '90s, but this has been slowly increasing the last few years. In 1991, for example, there were 110 active landfills in the state. Ten years later, in 2001, 52 landfills were active. Only three percent more solid waste, however, was sent to those 52 active landfills that was landfilled in the 146 landfills in use in 1987. Based on this, it appears that the solid waste management program that the state has in place is holding its own. In the 2001 report, the Illinois EPA projected that landfill capacity in the state was sufficient for at least into the year 2015.
[See activities 8 & 9.]

Region	Active Landfills	Tons of Waste Landfilled
One: Northwestern Illinois	8	3,185,496
Two: Chicago Metropolitan	13	4,193,999
Three: Peoria/Quad Cities	8	1,320,393
Four: East Central Illinois	9	4,230,166
Five: West Central Illinois	4	538,902
Six: Metropolitan East St. Louis	6	1,882,670
Seven: Southern Illinois	4	602,982

Recycling: The opportunities to recycle solid waste in Illinois are many and varied. These opportunities include curbside recycling programs, drop-off centers, commercial recycling, school recycling, institutional recycling and composting, among others. Some recycling is mandatory but much of it is voluntary. Thirty-one counties (Brown, Carroll, Cass, Cook, Franklin, Grundy,

Henderson, Henry, Jackson, JoDaviess, Kane, Kendall, Knox, Logan, Madison, Marshall, Mason, McDonough, McHenry, Mercer, Peoria, Pike, Putnam, Rock Island, Sangamon, Schuyler, Scott, Stark, Stephenson, Warren and Whiteside) as well as the city of Chicago have some form of mandatory recycling ordinances. The average Illinois resident recycled 864 pounds of material in 2001.

There are no mandatory recycling reporting requirements in Illinois. This makes it difficult to get accurate recycling statistics. However, recycling statistics were reported in *Recycling in Illinois: A Summary of Programs and Projects*. According to survey data for 2001 (compiled by the Illinois Recycling Association), curbside recycling programs available throughout the state serve approximately 2.6 million households. Over 271 drop-off recycling centers are available in 41 counties, and 281 locations that pay for recyclables (buy back centers) are located in 11 different counties. Forty-five thousand businesses take part in recycling while two counties (Peoria and Kane) and five cities have mandatory commercial recycling laws. About 3,500 schools recycle solid waste. Landscape waste is composted at 43 facilities, totaling 333,701 tons. The Illinois EPA, which collects recycling data annually from county recycling coordinators, reports that for 2001 the recycling rate - including composting - was 26 percent.

The table below presents data related to recycling and composting in Illinois, region by region, in 1998 as reported by the Illinois EPA in *Nonhazardous Solid Waste Management and Landfill Capacity In Illinois: 2002.*

Region	Tons of Waste Recycled	Tons of Compost Waste Accepted
One: Northwestern Illinois	238,608	53,345
Two: Chicago Metropolitan	4,256,119	182,320
Three: Peoria/Quad Cities	214,230	17,511
Four: East Central Illinois	193,224	20,993
Five: West Central Illinois	113,633	1,124
Six: Metropolitan East St. Louis	186,758	57,121
Seven: Southern Illinois	52,298	1,287

Since 1988, the Illinois recycling rate has increased from 2 percent to 26 percent. During the same period, the number of various types of recycling programs has continued to grow. In addition, as many as 25 counties with almost 77 percent of the state's population have achieved the 25 percent recycling rate mandated by the Solid Waste Planning and Recycling Act. It appears that Illinois' efforts to encourage recycling have succeeded.

Incineration: In 1996, Illinois had only one active incinerator, the Chicago Northwest Incinerator in Chicago. This incinerator burned 83,972 tons of solid waste in 1996 before it closed in June of that year. The following year, another incinerator opened in Robbins, Illinois. It accepted 461,960 tons of solid waste in 1998 for combustion. With the closure of this facility in 2000, Illinois no longer has any active municipal solid waste incinerators.

Activities

Objectives for Chapter 1 Activities

Activity 1: Reduce Your Use: The student will be able to list three ways he/she can reduce his/her use of each of the following solid waste materials: paper, plastic, steel, aluminum, and glass.

Activity 2: Reuse It! Given a list of eleven common disposable items, the student will be able to identify at least two different ways in which each can be reused.

Activity 3: Is It Recyclable? The student will locate in a grocery store at least five plastic product containers, each of which is manufactured from a different plastic resin. Also, the student will determine if these types of plastic are recyclable locally and, if not, why not.

Activity 4: Construct a Model Landfill: Provided with appropriate materials, the student will construct a scale model of a sanitary landfill.

Activity 5: Student's Home MSW Inventory Worksheet:

A. Each student in the class will determine how much solid waste his/her family produces in a five-day period.

B. The students (individually or in small groups) in the class will do each of the following: (a) calculate how much waste all the students' families create in a five-day period, (b) determine how much waste all the students' families would create in a year, (c) determine how much waste would be produced per person per year, and (d) construct a bar graph which depicts the different amounts of the different solid wastes created by all the students' families in one year. The students will compare their results with the averages for Illinois.

Activity 6: Your Landfill: The student will demonstrate the ability to use the reference source *Nonhazardous Solid Waste Management and Landfill Capacity In Illinois* to locate and identify specific information about the landfill closest to his/her school.

Activity 1: Reduce Your Use

Paper, plastic, steel, aluminum, and glass are five major categories of materials that are landfilled in Illinois. Paper products include newsprint from newspapers, paperboard from cereal boxes, cardboard from boxes, notebook paper, magazines and junk mail. Ketchup and mustard bottles, milk jugs, water and soda bottles, and laundry detergent containers are all made from plastics. Many kinds of fruit and vegetables are sold in steel cans, and aluminum cans are popular beverage containers. Many products from mayonnaise to pancake syrup are put in glass jars or bottles.

In order to cut down on the amount of solid waste that is sent to Illinois landfills, you can reduce your use of paper, plastic, steel, aluminum and glass. Below, please list three ways you can reduce the amount of these five materials you use.

Paper:

1. _____
2. _____
3. _____

Plastic:

1. _____
2. _____
3. _____

Steel:

1. _____
2. _____
3. _____

Aluminum:

1. _____
2. _____
3. _____

Glass:

1. _____
2. _____
3. _____

Activity 2: Reuse It!

Below are listed a number of items that are often thrown away. By reusing these things, we can reduce our impact on the environment by using fewer resources to make new items and by keeping them out of the landfill.

Work in small groups and "brainstorm" as many different ways as possible to reuse each item. Then, present your list to your classmates.

1. Mayonnaise jar:

2. Plastic shopping bag:

3. Paperback books:

4. Soda bottles:

5. Pieces of paper:

6. Old shoe:

7. Milk jug:

8. Junk mail:

9. Lumber scraps:

10. Worn out clothes:

11. Rubber bands:

12. Other: _____:

13: Other: _____:

14: Other: _____:

Activity 3: Is It Recyclable?

There are several kinds of plastic resins that are used to make containers that hold food and beverage items. In the table below you are given the names of the plastics and their codes. Your first assignment is to go to a grocery store and find foods that are sold in containers made from the different plastic resins. (The codes usually appear on the bottom of the containers.) Once you have done this, try to find out if the recycling program(s) available to you will accept any or all of the plastics for recycling and, if not, why not.

Plastic Type and Code	**Product Container Using this Plastic**	**Is This Recyclable?**	**If Not, Why Not?**
PETE - 1 polyethylene terephthalate			
HDPE - 2 high density polyethylene			
V - 3 vinyl/polyvinyl chloride			
LDPE - 4 low density polyethylene			
PP - 5 polypropylene			
PS - 6 polystyrene			

Activity 4: Construct a Model Landfill

Modern sanitary landfills are huge pits in the ground with a liner along the sides and bottom, which prevents waste from coming into contact with the earth. The liner has five layers. The bottom layer is made of two feet or more of compacted clay. The layer above the clay is made of thick, flexible plastic. Above the plastic is one foot of gravel. Above the gravel is a layer of geo-textile fabric. The top layer is one foot of compacted soil. Landfill operators then place the garbage on top of this five-layer liner. Refer to figure on page 17.

Your assignment is to construct a model of a landfill. You will need:

Modeling clay
A piece of flexible plastic
Pea gravel
A piece of cloth
Some soil
An aquarium or terrarium or wide, deep clear bowl

Directions: In the container, place some soil to serve as the ground above which the landfill will be constructed. Then, using the materials listed above, construct (to scale) the model of the landfill. When finished, place trash in the landfill and pour in some water to simulate precipitation. Is your landfill leak-proof? Or, does some water percolate through your landfill to the soil beneath it? If your landfill leaks and it was a real landfill, what problems could this cause for people living nearby?

In some countries, the poor attempt to scrape out a living by picking usable materials out of large open dumps at the outskirts of large cities. Often they will build homes from salvaged materials and live in and around the dumpsite. The non-existent sanitation and environmental pollution breed misery, disease and short lives for the children who live here.

Activity 5: Student's Home MSW Inventory Worksheet

Instructions: Below is a chart that includes the typical kinds of solid waste found in an Illinois landfill. In order to help you see how much solid waste your family generates, fill in the chart each day, Monday through Friday, and calculate totals. Then, answer the questions below.

	Monday	Tuesday	Wednesday	Thursday	Friday	Totals	
Paper **Newsprint** Amount (lbs.)							
Paper **Other Paper** Amount (lbs.)							
Metals Amount (lbs.) Examples							
Plastics Amount (lbs.) Examples							
Food Waste Amount (lbs.) Examples							
Glass Amount (lbs.) Examples							
Other Amount (lbs.) Examples							

1. How many people were generating the waste totals?
2. Determine how much of each kind of waste your family plus those of your classmates generate in one five-day period.
3. Based on what you found in Question No. 2, how much waste would be generated in a year?
4. Based on what you calculated in Question No. 3, how much waste would be generated per person during a year?
5. Create a bar graph that shows the amounts of each type of solid waste created during a year by the families of the students in your class.

Activity 6: Your Landfill

For this activity, you will need to obtain the most recent edition of *Nonhazardous Solid Waste Management and Landfill Capacity In Illinois*. You may obtain a copy of this report by contacting the Illinois EPA at 217/782-9288; TDD 217/782-9143 .

Directions: Use the map and the appropriate tables in this report to locate the following information.

1. In what region of the state is your county located?

2. Locate and name the landfills in your region.

3. Which landfill is located closest to your school?

4. What company operates this landfill?

5. What types of solid waste does the landfill accept?

6. What is the permitted disposal area of the landfill in acres?

7. What type of methane collection system does the landfill have?

8. How many leachate-monitoring wells check for water safety around the landfill?

9. How many years of capacity remain for the landfill?

10. What is the landfill's estimated remaining capacity in tons?

11. How much waste was accepted at the landfill for the most recently reported year?

12. Was the amount identified in Question No. 11 more or less than the amount of solid waste accepted in the previous year? How much more or less?

13. What reasons can you think of for the change you found in Question 12?

Project: Composting with Worms: A Vermiculture Project

Introduction

Learners of all ages will consider it fun raising worms and, at the same time, learn how to set up and maintain a vermiculture container. Red wigglers work best in a worm composter and, if the project is successful, they will reproduce very effectively.

A worm composter can be used to recycle **organic** material like food scraps into a valuable, nutrient rich soil conditioner/fertilizer. Worms eat the decomposing food scraps, which are digested and become compost as they pass through the worm's body.

How to Go About It!

Plans for building a worm box are included on the next page. You can also use other shallow boxes. Sometimes an old aquarium can be used or a plastic or wooden container. We have recommended a two by two-foot box, but a smaller one can work just as well. If you use our worm box, you will want to put it on a piece of heavy plastic such as an old shower curtain. Cardboard boxes, even with a plastic lining, are not recommended. We prefer better drainage and air circulation than this strategy would permit.

Once you have the worm box prepared, you should cut very narrow newspaper strips to provide bedding material. A commercial bedding material is available at most sporting goods stores, but it is not necessary to use this. If you can find someone who will run regular newspaper though a shredder for you, this will be a very satisfactory solution for a bedding supply. You will wind up with handfuls of shredded newspaper, which need to be misted with water until damp but not dripping wet. This is put into the composter until almost full. Remember that worms need moisture, food, a dark environment, and temperatures on the warm side. Even some fallen leaves crumpled up and mixed with the newspaper will help. Add a small sprinkle of fine sand to aid their digestion.

Where Can You Find an Initial Population of Worms?

Perhaps the easiest place to buy a few dozen worms is at a bait shop. Just be sure that the worms that are sold to you are healthy and active. If someone is raising red wigglers (*Eisenia foetida*) commercially in your locality, perhaps you can buy a hundred worms at wholesale. Or, they can be mail-ordered from a worm farm. Be sure to buy the small red wigglers, not the larger night-crawlers, as these will not create the desired compost.

What Can You Feed the Worms?

Vegetable scraps work well in a worm composter, as does raw fruit and fruit rinds like chopped apple cores or banana peels. The smaller the pieces one puts into the composter the quicker they will be consumed by the worms. Coffee grounds and tea leaves can be used in small quantities. Acidic fruit (like grapefruit rinds) and should be used sparingly due to the high acid content. However, excess acid can be neutralized by adding crushed egg shells to the composter. You may wish to avoid vegetables with strong odors such as cabbage, onions, and broccoli. They will compost well but if not consumed quickly enough by the worms, they can cause odor problems. Meat and other oily or fatty materials are NOT recommended for the same reason. Always bury the food scraps under the bedding to avoid attracting other insects and to prevent fruit fly eggs on fruit rinds from hatching.

Harvesting the Worms

In a few months you should find that your box has large quantities of compost and not much bedding left in it. It is at this time that you can and should "harvest" your worms. There are several methods for doing this, but we will suggest a quick, although somewhat messy, method.

Simply empty the contents of your worm composter onto a piece of plastic and divide the material into several piles. The worms will migrate away from the light and to the bottom of the piles. There, they can be caught. Now you can remove the compost and separate this from any remaining newspaper and food. Into the worm box you will simply add new bedding, some food material and some worms. If you keep the newly separated compost in a warm, dark place for a week or two, you will find that additional worms have hatched from cocoons in the compost.

At the right season you can offer excess worms to gardeners who want to increase the productivity of their garden soil. You might also offer the compost, which can greatly improve soil fertility. Remember, with enough composters going you could even go into the worm business.

Sometimes, in order to demonstrate the effectiveness of this kind of project, you might want to keep records over a six-month or twelve-month period. The worms can be weighed to determine their biomass. The compost can also be measured by weight or volume. A scientifically managed worm composting activity could even wind up being a fine science fair project. For more details on vermicomposting, see Appendix C for reference books.

Building the Worm Composting (Vermicomposting) Box

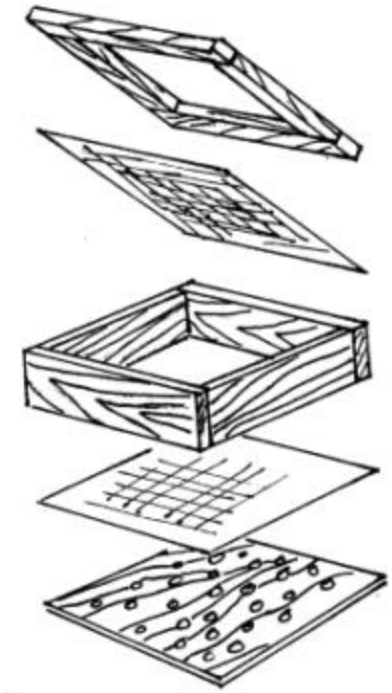
A) Top Frame
- 4 – 2”x2”s
- 2 hinges on back
- hook & eye on front

B) 24”x24” Screen Lid
- Staple screen to underside of top frame.

C) 2”x6” Box Frame (24”x24”)
- 4 – 2”x6”s

D) 24”x24” Screen
- Staple screen over bottom of box frame.

E: 24”x24”x ½” Plywood
- Drill about 20 – ½” holes for drainage.



MUNICIPAL SOLID WASTE AND THE 4Rs

CHAPTER 2

Analyzing Municipal Solid Waste Issues

Learner Objectives for Chapter 2

Upon completing the content and skill development associated with this chapter, the learner will be able to . . .

1. . . . Explain the relationships that exist between events, problems, and issues.
2. . . . Provide examples of municipal solid waste problems that lead to issues.
3. . . . Define the following terms: a. problem, b. issue, c. belief, d. value.
4. . . . Analyze given issues and identify the issue, the players, the players' positions, the players' beliefs, and the values that are associated with these positions and beliefs.

The ubiquitous aluminum pop can! Few see this as an issue in today's society, but the litter involving soda cans can be alarming. Those who toss them along America's roads and highways certainly demonstrate a lack of environmental values while those who pick them up and recycle them are acting on positive environmental and/or economic values. **Photo courtesy H. R. Hungerford.**

Understanding MSW Issues in Depth: Issue Analysis*

Man-made Events, Problems, and Issues

Humans undertake many activities and practices that they believe are worthwhile. Too little is probably said about human activities: the goods and services produced by businesses and industries; the art, literature, and music generated by artists; the knowledge of natural processes and species researched by scientists; and the philosophical, religious, educational, and recreational activities that allow humans to find meaning and fulfillment in their lives.

However, human activities do cause problems . . . many kinds of problems. These problems do not usually arise from natural events but rather from man-made events. Events such as the use of agricultural chemicals, the poaching of the African elephant, the burning of fossil fuels, the genetic alteration of domesticated plant and animal species, the conversion of wetlands to human use, the worldwide deforestation of tropical forests, the use of illegal dump sites for the disposal of MSW, etc., are all the result of human activities and all offer an array of problems that threaten the status of someone or something. Man-made problems, just like those caused by natural events, often lead to environmental **issues**. Different persons have different **beliefs** and **values** about the issue or its solution. Thus, an issue arises because there is not agreement about what should be done to resolve the issue.

It is impossible to understand an issue by looking at it from only one point of view. By finding out what other individuals or groups of people think about an issue, we can help to round out our own understanding of the issue. Also, if we can discover why the other people feel the way they do, we will further add to our comprehension of the issue in question. Looking at a person's beliefs about an issue, and the personal values that underlie these beliefs, is a good place to start to understand an issue.

About Beliefs and Values: What Are They?

When we speak of beliefs and values, we are getting to the heart of the issue! People may take different **positions** on the solution to MSW issues. The position a person takes usually depends upon his or her beliefs and values. A **belief** is an idea that a person (or a group) holds to be true. The idea may or may not be true, but the person believes it is. In many cases, a person's beliefs are strongly tied to his or her values**.** A **value** is the worth a person (or a group) places on something. Usually, our values guide us in the choices we make.

It is helpful for us to be aware of our beliefs and values. This is so because conflicts sometimes arise within a person. On occasion, when trying to make a decision you may feel like you are caught between differing values. The choice may simply be between two different values. When it comes to taking a position on an issue, you might find yourself between a rock and a hard place. This is not unusual. On one hand you can

* Much of this section is taken directly or modified from *Investigating and Evaluating STS Issues and Solutions,* Stipes Publishing Company, ©1997. pp. 33-58.

hold very strong environmental values about an issue but, on the other hand, you might have equally strong recreational, egocentric, or social values about it. These values can be in conflict. Everyone experiences these conflicts on occasion.

For example, you might have conflicting values concerning the consumption of fossil fuels. You realize that you need to consume fossil fuels on a daily basis. You use gasoline to travel to work, the grocery store, the movie theater, and your child's softball game. Coal generated electricity allows you to wash your clothes and dishes, play your TV and stereo system, and heat and cool your home. On the other hand, you realize fossil fuels are from nonrenewable resources and once used they are gone forever. Also, as you drive your car you release pollutants into the atmosphere, as does the plant that burns coal to produce the electricity you use. Should you avoid going to the movies or the softball game in order to save gasoline? Should you keep your thermostat set at a temperature at which you are not comfortable to reduce your consumption of electricity?

In order to understand and evaluate personal beliefs and values, it is helpful to inspect them and discuss them with others. Learners should have an opportunity to share their beliefs about MSW issues. They should also be able to talk about why they feel the way they do and just what it is that they value. Some of their ideas may change as a result of this discussion. They may also feel even more strongly about their ideas after a discussion.

See Activity 7: Identifying Values

There are a number of values that are commonly found in environmental issues. Those values are listed on the next page, along with their definitions. [You will want to duplicate this list for your students to use in Activity 7.] Often, what people say (their belief statements) can reveal their values. By reading or listening to their belief statements, we can infer what their major concerns are. The following section will provide additional information about how this type of language analysis is helpful in understanding environmental issues.

Corrugated cardboard has become an important material for recycling. Here, cardboard is being baled to await transport to a larger center where the material will be processed into other paper products.

Issue Value Descriptors

The descriptors listed below may be helpful as a person analyzes issues. These statements attempt to name and define values that might be held by individuals. The definitions, as well as the list itself, should not be considered complete. They are simply tools to help the learner with a rather complex task.

Value:	*Definition*
Aesthetic:	The appreciation of form, composition, and color through the human senses.
Economic:	The use and exchange of money, materials, and/or services.
Ecological:	The characteristics of natural biological systems and the self-regulation of naturally existing ecosystems without human interference.
Educational:	The accumulation, use, and communication of knowledge.
Egocentric:	A focus on self-centered individual needs and fulfillment.
Environmental:	Human activities as they relate to quality of natural resources, e.g., plant and animal species, air, water, soil, etc.
Ethical/Moral:	Present and future human responsibilities, rights and wrongs, and ethical standards.
Ethnocentric:	A focus on the fulfillment of ethnic/cultural goals.
Health:	The maintenance of positive human physiological conditions.
Legal:	Relating to regulations, laws, law enforcement, law suits.
Political:	The activities, functions, and policies of governments and their agents.
Recreational:	Human leisure activities.
Religious:	The use of belief systems based on faith or dogma.
Scientific:	The process of empirical research; knowledge gained by systematic study.
Social:	Shared human empathy, feelings, and status.
Technological:	The use of technology for human or societal goals.

The Basics of Issue Analysis

Beliefs and values shape the positions held about an issue. Therefore, it is important to be able to identify and interpret the beliefs and values at work in a real issue. Those humans who participate in an issue are called '**players**." Each player has a "position" (what he or she thinks should be done) on the issue. There are several key elements of an issue. These include:

Players: individuals and groups of individuals involved in the issue.

Positions: what each player thinks should be done to resolve the issue.

Beliefs: important ideas held by the players that shape their positions.

Values: what is important to the players as reflected in their beliefs.

To help you and your students better understand how these four elements function in a MSW issue, we will report a fictitious meeting of the Board of Supervisors of Bigg County. The article is found on the following page, and can be duplicated for your students to use in Activity 8.

See Activity 8: Issue Analysis Article and Worksheet for Analyzing the Bigg County Landfill Story

After reading a MSW issue article, the very first thing that should be done is to determine what the issue actually is. A good way to do this is to decide what the people, organizations, and/or groups disagree about. In the "Bigg County Landfill Meeting Chaotic" article, the residents of Bigg County disagreed on whether there should be a new landfill in the county. Therefore, the issue is, "Should *a new landfill be sited in Bigg County?"* A question is often a good way to state an issue because it allows the people involved in the issue to put forth their position on the issue by directly answering the issue question.

The people, organizations, and/or groups involved in an issue are called players. In the Bigg County landfill issue, the main players appear to be: B. J. Flim, Catherine Ashe, W.J. Trucker, Vernon Speakwell, Elsie Clapper, and Bill Barker.

The way each of these players would answer the issue question is that player's position. For example, B. J. Flim's position is, "Yes, a new landfill should be sited here." Vernon Speakwell's position, on the other hand is, "No new landfill should be sited in Bigg County."

The reasons why players take the positions they do are found in what they say about the issue in their belief statements. For example, one reason that Flim favors a new landfill is that the current, aging landfill is polluting the stream in the town of Miller's Creek. Bill Barker, who opposes the landfill, believes that the new landfill would be a perpetual eyesore and that waste would be blown all over that part of the county.

In all of this, specific values underlie the beliefs and positions that are taken by the players in an issue. The value, which underlies B. J. Flim's belief, is an *environmental value*. We can call this an environmental value because B. J. was concerned about a human activity polluting the stream. Mr. Barker's belief about the landfill being an eyesore is based on an *aesthetic value*. He was concerned about how the nearby area would look.

Bigg County Landfill Meeting Chaotic

NIMBY (UPG) - The Bigg County Board of Supervisors landfill meeting last night in Nimby turned out to be a battle of wills. On one hand, the County Board had already conducted several studies in the county that indicated that the proposed landfill could be safely sited there. On the other hand, numerous county residents are violently opposed to having any landfill in their county.

County Board President B. J. Flim opened the meeting with an emotional appeal for the landfill. Flim noted that the existing landfill near the town of Miller's Creek was nearing capacity and polluting the stream that ran through it.

He also noted that the Miller's Creek Landfill did not meet EPA standards for a sanitary landfill and that the County Board feared that the county could be fined if it continued to use the landfill. Flim also reported that consulting engineers from Dragline, Inc., had assured him that the new 200-acre site northwest of Nimby would be perfect for the development of a sanitary landfill that met all environmental standards.

At that point Flim asked Catherine Ashe from the law firm of Ashe, Dumpp, and Burns to speak. Ashe provided assurances that the new landfill would be completely legal and that it would ease the fear of a possible lawsuit against the County Board for continued use of the Miller's Creek Landfill.

Flim then asked the President of the Midwest Waste Managers, W. J. Trucker, to speak. Trucker agreed that a new landfill was sorely needed and that his corporation would run it in accordance with EPA standards. He also stated that the landfill would be environmentally friendly, that there would be no odor, that there would be no leaking into surface or ground water, and that any methane production could be tapped for usable energy.

Trucker then told the gathering that he had been contacted by municipalities in Indiana, Kentucky and Missouri about accepting their solid waste for which they would pay premium tipping fees. This news resulted in a chorus of groans and boos from the audience.

After warning the audience to cease interrupting the session, Flim opened the meeting up to the audience. The first speaker was Vernon Speakwell, the head of the Bigg County Conservation Council who questioned the location of the proposed landfill.

Speakwell pointed out the proximity of the site to the poorest part of the county where the residents had the least say in what happened to them. He also questioned the politics of the situation and wondered just who would profit.

Speakwell also said that the Conservation Council had contacted another law firm and had been told that it could go to court and get an injunction against the County Board to delay the new landfill until neutral engineering and geology consultants could be brought in to survey the entire situation. This statement brought applause from the audience, apparently rather hostile toward the Board and the landfill scheme.

The next speaker was Elsie Clapper, President of the Bigg County Garden Club Consortium. Clapper told the group that the Consortium was shoulder to shoulder with Speakwell's group and that they would help fund the neutral consultants.

Bill Barker spoke next and addressed the gathering in very heated tones. He chastised the Board for not involving local citizens in planning for the new landfill. He seconded Speakwell's concern for the environment and applauded Clapper's willingness to help support that effort. One of his most argumentative statements centered on what appeared to be the Board's willingness for Midwest Waste Managers to profit from out-of-state "garbage."

Barker said many local citizens were also concerned that the new landfill would be a perpetual eyesore and that waste would be blown all over that part of the county just like it was at Miller's Creek. He also wondered aloud just who on the Bigg County Board would get wealthy from the new landfill. Applause, whistles, and shouts of agreement followed Barker's statements.

Flim asked for order in the meeting room, and getting none, closed the meeting without the Board having reached any consensus. The next meeting of the Bigg County Board is scheduled for November 26th.

Activities

Objectives for Chapter 2 Activities

Activity 7: Identifying Values: Given a list of statements incorporating a variety of values, the student will identify the value that each statement represents.

Activity 8: Issue Analysis Article and Worksheet for Analyzing the Bigg County Landfill Story: Given an issue-based story and a partially completed worksheet, the student will identify the remaining players, positions, beliefs and values on the worksheet.

Some interesting beliefs and values can be inferred from this photo of a dumpsite along a waterway. Among other things we can identify paper, cardboard, glass, metal, and plastic - even polystyrene foam. What sorts of beliefs and values might be reflected here? What other beliefs and values might help in counteracting this kind of waste disposal behavior?

Activity 7: Identifying Values

Directions: This activity provides practice in inferring the values, e.g., moral, aesthetic, political, etc., that seem to influence various human beliefs. The following statements reflect various beliefs about municipal solid waste. Please read each statement and identify the value that seems to be influencing the speaker's belief. List the name of the value in the space provided. It is sometimes helpful to underline the words or phrases which indicate a specific value to you. Note: In some instances more than one value might be justified.

Value	*Belief Statement*
	1. You can sell aluminum cans at the drop-off center for 35 cents a pound.
	2. State laws require each county to recycle 25 percent of its solid waste.
	3. One can learn a lot about Illinois solid waste management by visiting the Illinois EPA's web site.
	4. That sweatshirt made from recycled plastic is gorgeous.
	5. Humans are responsible for the wise use of natural resources.
	6. Our recycling club really enjoys the all the fun we have working together after school.
	7. That new shredding machine can shred plastic three times faster than the one it replaced.
	8. Research shows that it is necessary to buy products with recycled content to make recycling work.
	9. Swamps and marshes are very important to plants, animals, and fresh water supplies.
	10. If we log a forest carefully, we can preserve the checks and balances that exist in that ecosystem.
	11. The Germans have a strong tradition of recycling solid waste.
	12. If leachate from leaking landfills gets in to well water, it can make you sick.
	13. The Illinois state legislature passed the Environmental Protection Act.
	14. I can throw empty pop cans out of the car along the highway anytime I want to.

Suggested Answers - Activity 7

Directions: This activity provides practice in inferring the values, e.g., moral, aesthetic, political, etc., that seem to influence various human beliefs. The following statements reflect various beliefs about municipal solid waste. Please read each statement and identify the value that seems to be influencing the speaker's belief. List the name of the value in the space provided. It is sometimes helpful to underline the words or phrases which indicate a specific value to you. Note: In some instances more than one value might be justified.

Value	***Belief Statement***
Economic	1. You *can sell* aluminum cans at the drop-off center for *35 cents* a pound.
Legal	2. *State laws require* each county to recycle 25 percent of its solid waste.
Educational	3. One *can learn* a lot about Illinois solid waste management by visiting the Illinois EPA's web site.
Aesthetic	4. That sweatshirt made from recycled plastic is *gorgeous*.
Moral/Ethical	5. Humans are *responsible* for the wise use of natural resources.
Social	6. Our recycling club really *enjoys* all the fun we have *working together* after school
Technological	7. That new shredding *machine* can shred plastic *three times faster* than the one it replaced.
Scientific	8. *Research shows* that it is necessary to buy recycled products to make recycling work.
Ecological	9. *Swamps and marshes* are very important to *plants, animals,* a*nd fresh water* supplies.
Environmental	10. If we *log a forest* carefully, we can *preserve the checks and balances* that exist in that ecosystem.
Ethnocentric	11. The *Germans* have a *strong tradition* of recycling solid waste.
Health/Safety	12. If leachate from leaking landfills gets in to well water, it *can make you sick.*
Political	13. The Illinois *state legislature passed the Environmental Protection Act.*
Egocentric	14. *I can* throw empty pop cans out of the car along the highway anytime *I want to*.

Activity 8: Issue Analysis Worksheet for Analyzing the Bigg County Landfill Story

Please read the article that your teacher will provide. This article is a fictitious report about a meeting of the Board of Supervisors of Bigg County. The partially completed worksheet below presents an issue analysis of the Bigg County landfill MSW issue. You will see that the issue has been identified, and that each of the major players is listed. Your task is to fill in the missing items (positions, beliefs and values).

The Issue: Should *a new landfill be sited in Bigg County?*

The Player & Position	Belief Statements	Value
B.J. Flim Position: Yes	1. The aging landfill is polluting the stream that flows through the town of Miller's Creek. 2. The Miller's Creek landfill does not meet EPA standards.	1. Environmental 2.
Catherine Ashe Position: Yes	1.	1.
W.J. Trucker Position:	1. His corporation would operate the landfill in accordance with EPA standards. 2.	1. Legal 2.
Vernon Speakwell Position: No	1. 2.	1. 2.
Elsie Clapper Position:	1.	1.
Bill Barker Position:	1. The new landfill would be a perpetual eyesore and waste would be blown all over that part of the county. 2.	1. Aesthetic 2.

Suggested Answers - Activity 8

To the teacher: You will notice that several of the players have multiple belief statements (and related values). Be prepared to ask students *WHY* they have inferred the values they did and to discuss the various answers. Sometimes, more than one value can be inferred within a belief statement. If the student can justify his or her inference, that answer would be considered acceptable.

The Issue: ***Should a new landfill be sited in Bigg County?***

The Player & Position	Belief Statements	Value
B.J. Flim Position: Yes	1. The aging landfill is polluting the stream that flows through the town of Miller's Creek. 2. The Miller's Creek landfill does not meet EPA standards and the county could be fined. *3. Consultants assure him that the new site would meet all environmental standards.*	1. Environmental 2. *Legal* 3. *Legal*
Catherine Ashe Position: Yes	1. *The new landfill would be completely legal and will ease the fear of a lawsuit.*	1. *Legal*
W.J. Trucker Position: Yes	1. His corporation would operate the landfill in accordance with EPA standards. 2. *The new landfill would be environmentally friendly . . . no odor . . .no leaking . . . methane could be tapped for energy production.* 3. *Municipalities in Indiana, Kentucky and Missouri will pay premium tipping fees.*	1. Legal 2. *Environmental* *Aesthetic* *Health/Safety* 3. *Economic*
Vernon Speakwell Position: No	1. *The site is near the poorest residents who have the least say.* 2. *Questioned politics and who would profit.* 3. *Could get an injunction.*	1. *Ethical/Moral* 2. *Political* *Ethical/Moral* 3. *Legal*
Elsie Clapper Position: No	1. *Consortium is shoulder to shoulder with Speakwell's group and will help fund neutral consultants.*	1. *Social/ Economic*
Bill Barker Position: No	1. Voiced concern that new landfill would be a perpetual eyesore and waste would be blown all over that part of the county. 2. *Chastised Board for not involving local citizens.* 3. *Wondered which Board members would get wealthy from the new landfill.*	1. Aesthetic 2. *Political* 3. *Economic* *Ethical/Moral*

MUNICIPAL SOLID WASTE AND THE 4Rs

CHAPTER 3

Investigating Issues Related to Municipal Solid Waste and the 4Rs

Learner Objectives for Chapter 3

Upon completing this chapter, students will be able to . . .

1. . . . Identify a waste reduction or recycling issue.
2. . . . Research (using secondary sources of information) the scientific and social information critical to that issue.
3. . . . Analyze the important players involved in the issue in terms of their positions, beliefs, and values.
4. . . . Generate suitable research questions focused on important elements of the issue.
5. . . . Prepare an appropriate research instrument that will answer the research questions.
6. . . . Select a valid sample from an identified research population from which to collect data.
7. . . . Collect data from the identified sample using the research instrument.
8. . . . Generate appropriate charts and/or graphs for a visual presentation of the collected data.
9. . . . Correctly interpret the collected data by making suitable conclusions, inferences, and recommendations.

Issue Investigation: An Overview for the Teacher

The activities in this chapter will involve your students in investigating a MSW issue. An example of a MSW issue investigation will be presented. If you choose to involve your students in the steps outlined in this chapter, you will lead your students through a research procedure that will allow them to use scientific methods to investigate a MSW issue. The investigation types are typically questionnaires and opinionnaires. You might choose to follow the example and conduct a similar investigation as a class project. Or, you might choose to allow your class to develop its own issue investigation from scratch. Other suggested topics might include:

- Should our school stop using disposable cutlery and dishware in the school cafeteria?
- Should our community's garbage collection fee be quantity-based?
- Should organic waste (compostables) be banned from our state's landfills.
- Should our state enact a "bottle bill"?

An issue investigation can be described as a scientific process of asking and answering a question about an issue. Why should your class do issue investigations? There seem to be several payoffs for students. Issue investigations allow students to learn about issues through direct, "hands-on" involvement. This is an exciting way to learn. Students also learn a lot about how scientific research methods work. And, an issue investigation is an important way to make sure that students have all the critical information they will need before beginning to make decisions about solving the issue.

A number of the activities described in this chapter involve the students working in groups. It is the intent of the authors that these groups should be conducted as a form of cooperative learning. Space here does not permit an extensive discussion of cooperative learning but the benefits of cooperative learning include:

• improved academic achievement,	• increased self-confidence and motivation, and
• improved behavior and attendance,	• increased enjoyment of school and peers.

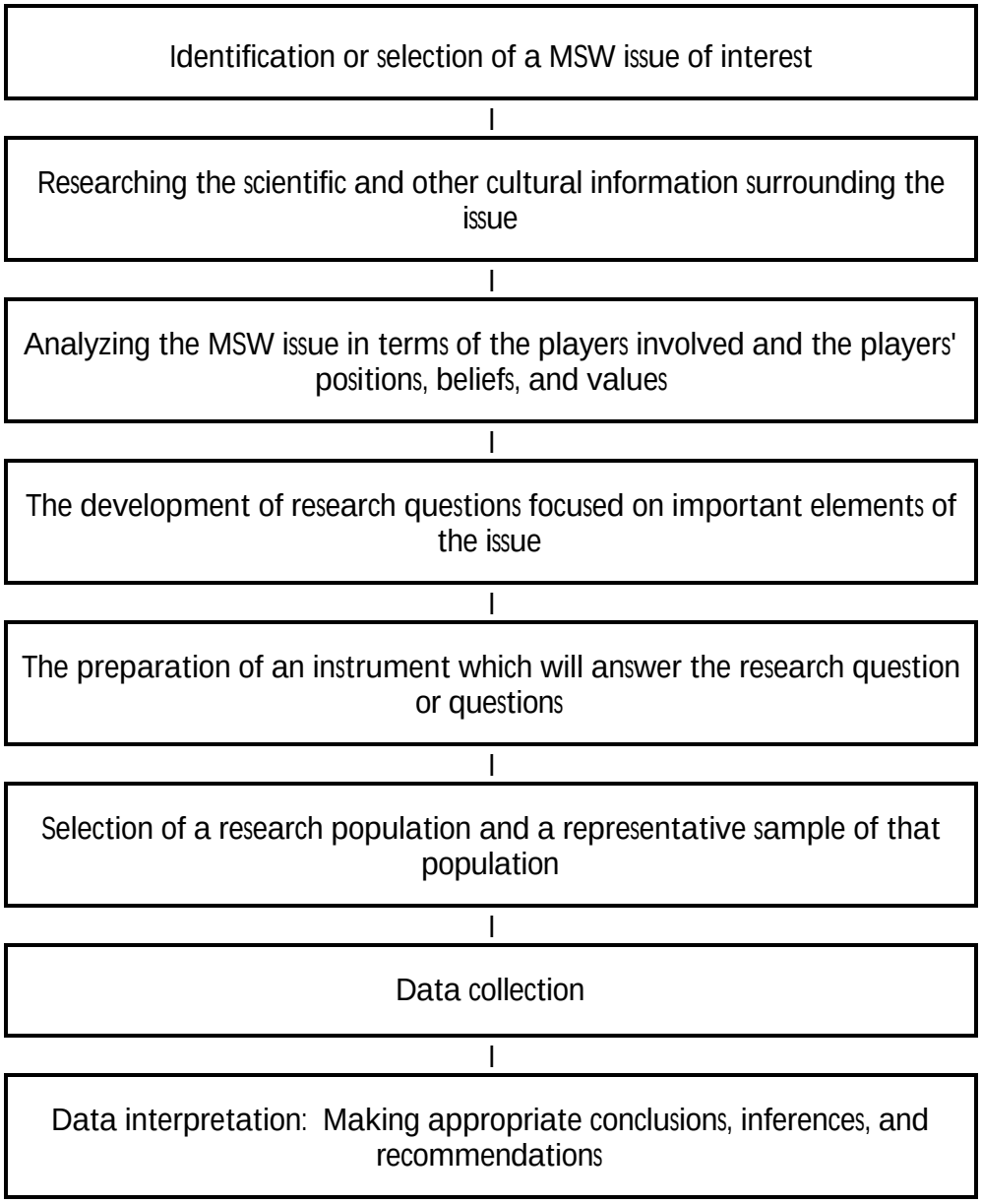
We encourage you to try this tool in your classroom if you have not yet done so.

> "When the students buy into the idea that this is their [issue investigation] project and that they think they can make a difference, it becomes something that you, as a teacher, don't need to supervise very much because the students become interested enough, honestly, to supervise themselves."
>
> Versil Withrow, Sixth Grade Teacher
> Wayne City, Illinois

The flow chart below outlines the logical sequence of events involved in an issue investigation. Following the flow chart, a fictitious issue investigation provides a step-by-step example of how an issue investigation develops.

An Issue Investigation Schematic:

A Flow Chart of the Municipal Solid Waste Issue Investigation Process *



* - As identified by Hungerford, et al., in *Investigating and Evaluating Environmental Issues and Actions*, Champaign, IL: ©1996 Stipes Publishing Company.

An Example Issue Investigation Using a Questionnaire

- ***Identification or selection of a MSW issue of interest.***

Dana and Pat are two middle school students in Murphydale, Illinois, who have to conduct an issue investigation for their social studies and science classes. They chose to work together to investigate the issue: **What kind of recycling program do the residents of Murphydale want?**

- ***Researching the scientific and cultural information surrounding the issue.***

See Activity 9: Locating Background Information

The two students had become interested in recycling when they read letters to the editor of the *Murphydale Gazette* by citizens who were debating the particulars of a needed recycling program for Murphydale. In order to better understand the issue, Dana and Pat decided they needed to locate background information on recycling and related topics such as the 3Rs, municipal solid waste, landfilling, and incineration. To get this information they used several Internet search engines, the Illinois EPA web site, the Illinois DCEO web site, magazine and journal articles, as well as books and CD ROM encyclopedias. The librarians at both their school library and the Murphydale Public Library assisted them in their search for information.

- ***Analyzing the MSW issue in terms of the players involved and the players' positions, beliefs, and values.***

See Activity 10: Randolph County Landfill Issue Analysis

Pat and Dana clipped letters to the editor from the *Murphydale Gazette*, as well as articles about possible recycling programs for the town. Using these sources, they were able to identify not only the issue but also the issue's players, the players' positions, and the players' beliefs that supported their positions. Based on the players' beliefs, the students were able to infer the values that guided those beliefs.

- ***The development of research questions focused on important elements of the issue.***

Rules for Research Questions

Activity 11: Research Question and Opinionnaire or Questionnaire (Part 1)

Research questions provide an exact focus on the information to be collected for the investigation. These questions guide the processes of planning the investigation, developing the questionnaire or opinionnaire, and interpreting the data that is collected. Time, energy, and resources have been wasted by student investigators who failed to clarify the questions they wanted to answer. It is doubtful whether an issue investigation (indeed, any scientific study) will be successful without appropriate research questions. Several rules for producing good research questions are presented below.

Issue investigation research questions . . .

1. . . . Are always stated **in question form**.

2. . . . **Avoid "Yes" or "No" answers**. This is usually achieved by using phrases such as "To what extent . . .," "In what ways . . .," and "What evidence indicates that . . . ."

3. . . . **Indicate a population and/or area**. The population refers to a group of human beings on which the research is focused, e.g., Des Plaines, Illinois condominium residents who participate in the city's recycling program. The area refers to the geographical location in which the data will be collected, i.e., within the city of Des Plaines.

4. . . . When possible, **specify the identification or measurement of a variable**. A variable is a factor or condition about which the data are to be collected; e.g., the number of abandoned cars within the city limits of Chicago.

5. . . . When possible, **specify a relationship between two variables**. That is, a research question might ask the extent to which one variable affects (or is associated with) another variable. The following research question seeks to measure the extent to which individuals' education levels affect their level of recycling. To what extent does high school graduation impact on the level of recycling among southern Illinois residents?

6. . . . Should be **important in a social and scientific (or environmental) sense**. Issues having importance for both human beings and the environment should be selected. [Example: To what extent does leachate leaking from abandoned Illinois landfills pose a threat to human health and welfare?]

Dana and Pat proposed the following research question for their issue investigation:

Research Question: **What do Murphydale residents want the parameters of the Murphydale recycling program to be?**

- ***The preparation of an instrument which will answer the research question or questions.***

There are basically three types of research instruments that can be developed:

Activity 11: Research Question and Opinionnaire or Questionnaire (Part 2)

A questionnaire is a carefully written set of questions about a particular subject that is asked of a specific **sample** of people. For example, a questionnaire could be given to the residents of a town to determine the extent to which they will support state legislation having to do with establishing a curbside recycling program in their county.

An opinionnaire is a carefully written set of questions, which measures the opinions of a specific sample of people. For example, an opinionnaire could be given to a city's residents to determine their opinions about proposed mandatory recycling of household solid waste.

A combination instrument: Many investigations combine the questionnaire and opinionnaire. That is, an investigation instrument might be designed to collect both information and opinions from a sample of citizens.

The two students developed the following questionnaire items to collect data in order to answer their research question:

Murphydale Recycling Questionnaire

1. Do you want a recycling program in Murphydale? Yes ___ No ___ Unsure ___.
   (If "Yes" please answer the questions that follow.)

2. Do you want the Murphydale recycling program to be voluntary or mandatory?
   Voluntary _____ Mandatory _____.

3. Should the recycling program be a curbside pickup program or a drop-off center program?
   Curbside _____ Drop-off _____.

4. What recyclable materials should be collected?

   Glass _____ Aluminum _____ Newspaper _____
   Plastic _____ Steel cans _____ Cardboard _____

5. Would you be willing to pay an extra fee for recycling services?
   Yes ___ No ___ Unsure ___.

- ***Selection of a research population and a representative sample of that population.***

The **population** of an issue investigation is that group of people from which data are to be collected. In the Murphydale recycling investigation, the population is all the residents of Murphydale.

See Activity 12: Selecting a Systematic Sample

If the population you have selected is small enough, you can collect data from all the people in that population. For example: a questionnaire could be sent to all residents with their utility bills. However, this is not often the case. This means that you must select a smaller portion, a sample, of the population. How you select your sample is very important.

In order to get answers that represent what all kinds of people in a population are thinking; you need to contact all those different kinds of people. In that way, your sample will represent the views of the larger population. This becomes what is called a **representative sample**. One of the most critical problems facing an investigator is that of making sure that the sample is representative. Then, and only then, can one be sure that the data collected are valid for the entire population.

There are several possible sampling methods for investigations. One that usually works well and is relatively easy to conduct is called a **systematic sample**. A systematic sample is one that is selected from an entire population using a "regular" or consistent system of selection. For example, if a researcher wanted to select 100 names from a 200-page phone book, he/she might take the first residential address and phone number from every second page. (Depending on the population, a sample size of between 70 and 100 is enough for most issue investigations. In general, the square root of the population is usually a good sample size.)

Pat and Dana utilized a systematic sampling technique using the Murphydale telephone directory to identify their sample. Their sample size was 100 and the Murphydale telephone book had 300 pages. The students decided to call the fourth residential address on every third page to locate their sample of 100 Murphydale residents. Dana and Pat decided that each would make 50 calls; Dana would call the first 50 numbers, and Pat would call the remaining 50.

- ***Data collection.***

The two students made their 100 phone calls. During phone call . . .

See Activity 13: Calculating Percentages *and* ***Activity 14: Making a Bar Graph***

1. A polite introduction was given.
2. An explanation for the call was provided.
3. The respondent's answers to the questions were collected.
4. A "thank you" for the participant's time and cooperation was given.

The data collected by Pat and Dana are presented below:

Murphydale Recycling Questionnaire

1. Do you want a recycling program in Murphydale? **Yes 97; No 3; Unsure 0.**
   (If "Yes" please answer the questions that follow.)

2. Do you want the Murphydale recycling program to be voluntary or mandatory?
   Voluntary 77; Mandatory 20.

3. Should the recycling program be a curbside pickup program or a drop-off center program?
   Curbside 93; Drop-off 4.

4. What recyclable materials should be collected?

Glass	**97**	**Aluminum**	**87**	**Newspaper**	**97**
Plastic	**96**	**Steel cans**	**93**	**Cardboard**	**71**

5. Would you be willing to pay an extra fee for recycling services?
   Yes 47; No 31; Unsure 19.

- ***Data interpretation: making appropriate conclusions, inferences, and recommendations.***

After data are collected and recorded, they must be interpreted. In issue investigation, students will need to draw conclusions from the data and make inferences from those conclusions. Then, they can use the conclusions and inferences to make recommendations. This is what the investigation is all about - being able to make good conclusions and inferences and then to make sound recommendations. The terms can be defined as follows:

See Activity 15: Conclusions, Inferences and Recommendations

Conclusions are factual summary statements of the results for the sample. They are sometimes called statements of observations.

Inferences are general statements about what the data mean for the population as a whole. They are based on the conclusions.

Recommendations are suggested actions concerning the issue based on the conclusions and inferences.

Dana and Pat made the following conclusions based on their data:

1. 97 percent of the sample wanted a recycling program in Murphydale.
2. 77 percent of the sample wanted the recycling program to be voluntary.
3. 93 percent of the sample wanted the recycling program to be a curbside pickup program.
4. Between 87 percent and 97 percent of the sample wanted aluminum, steel cans, plastic, glass, and newspapers to be collected. Only 71 percent wanted cardboard to be included in the program.

From their conclusions, the students generated the following inferences:

1. A very large majority of Murphydale residents want a voluntary, curbside-pickup recycling program for the town.
2. Although almost all the Murphydale residents think that aluminum, steel cans, plastic, glass, and newspapers should be collected in the recycling program, a lesser number want cardboard to be included.
3. A small additional fee for recycling might be acceptable to most Murphydale residents.

Following their conclusions, Dana and Pat made the following recommendations:

1. The Mayor and town council of Murphydale need to be informed of the results of the issue investigation.
2. A decision-making committee needs to be formed to finalize the recycling program.
3. A task force needs to be formed to get the recycling program underway.

Planning An Issue Investigation

Once the prerequisite skills for conducting an issue investigation have been developed, students are ready to investigate an issue of their choice. The decisions that need to be made in planning an issue investigation can be found in Activity 16.

See Activity 16: Planning an Issue

Activities

Objectives for Chapter 3 Activities

Activity 9: Locating Background Information: The student will be able to locate a variety of reference sources for the 4Rs topic.

Activity 10: Randolph County Landfill Issue Analysis: Given a newspaper article dealing with the issue of the siting of a landfill, the student will conduct an issue analysis of that article.

Activity 11: Research Question and Opinionnaire or Questionnaire: Based on a newspaper article dealing with the issue of siting a landfill, the student will develop both a research question and a short questionnaire or opinionnaire.

Activity 12: Selecting a Systematic Sample: From a list of 100 numbers, the student will select two different systematic samples and explain how each sample was selected.

Activity 13: Calculating Percentages: Given numerical data, the student will calculate percentages based on that data.

Activity 14: Making a Bar Graph: Provided with qualitative and quantitative data, the student will construct an appropriate bar graph.

Activity 15: Conclusions, Inferences and Recommendations: Given data from a surrogate issue, the student will develop one each of the following: a conclusion, an inference, and a recommendation.

Activity 16: Planning an Issue Investigation: The student will identify an issue relating to solid waste and/or the 4Rs and develop a plan for investigating that issue.

Activity 9: Locating Background Information

Assume that you need to find information about the 4Rs - Reduce, Reuse, Recycle, and Re-buy. There are many ways to locate this information. For example, you could use the card catalog or computerized card catalog at the library, the *Readers' Guide*, a variety of topical (subject) indexes and, of course, the Internet.

Using references available to you, please respond to the following tasks:

1. **Subject search**: Find a book about recycling. Fill in the following:
   A. Title:
   B. Author:
   C. Publisher:
   D. Year of publication:

2. **Title search**: Find a book, the title of which is *Easy Recycling Handbook: What to Recycle and How to Buy Recycled*. Fill in the following:
   A. Author:
   B. Publisher:
   C. Year of publication:

3. **Find two articles** about reducing and/or reusing and/or recycling solid waste.
   A. **Article 1**:
      a. Title:
      b. Author:
      c. Source:
   B. **Article 2**:
      a. Title:
      b. Author:
      c. Source:

Activity 10: Randolph County Landfill Issue Analysis

Below you will find an article about the proposed siting of a landfill in Randolph County, Illinois. On the next page you will find an issue analysis form. Please complete an issue analysis of this article on that form.

Arguments pit possible pollution against economic benefits

By Linda Rush
The Southern Illinoisan - August 22, 1998

Opponents of a proposed new landfill in Randolph County will meet at 6 p.m. Sunday in the City Lake Pavilion on Illinois 4 near Sparta.

Proponents say having a "mega-landfill" in the county will help lure industry. Opponents fear pollution of the Sparta city water supply, dangerous and unmanageable truck traffic on roads leading to the site and a possible influx of industrial waste.

Allen Weber is president of a group called Fighting Opponents for Randolph County Environment, which he says is growing rapidly as more people learn the true nature of the landfill plans. Sunday's meeting will be the fourth for FORCE.

Land and Lakes, a Park Ridge company, has proposed building a landfill on Holloway Road, less than half a mile from the Sparta city reservoir, which supplies water - both to Sparta and to the new Egyptian Water System that is extending water service in the county. Land and Lakes had no one available Thursday or Friday to comment on the landfill plans, but company officials did fax written replies to questions late Friday.

The company's statement said that over its life, the Sparta *facility* will generate up to $27 million in disposal fees for Randolph County, will reduce long-term waste disposal costs for county residents and businesses and will include a recycling drop-off/buy-back center for county residents at no cost to the public. It is also estimated that the facility would have about 10 full-time regular employees, plus at least 20 employees during construction. The landfill will occupy 200 acres of an approximate 750-acre parcel, and will have a capacity of 35 million cubic yards. Weber's group says the trash could be 250 feet high.

The landfill will serve 49 counties in Missouri, Illinois and Kentucky, and will not accept hazardous waste. It will accept non-hazardous municipal solid waste from residential, commercial and industrial sources, the company said. It said traffic would vary from day to day, but estimated 68 trucks per day to the landfill during initial operation. The firm added that it "is committed to assisting Randolph County" in improving roads to handle the increased traffic.

FORCE's Weber said the facility would be built on farmland with some residences less than 50 yards away.

"There are at least 35 families living right on the boundary of the site," Weber said.

Land and Lakes said the location is geographically well suited for a sanitary landfill; other sites were considered before it was chosen.

The company said it has operated five sanitary landfills, six composting facilities and one liquid waste treatment plant in Illinois, all in the Chicago metropolitan area.

Randolph County Clerk Bill Rabe said he had received 113 letters opposing the landfill and only 15 supporting it by late Thursday afternoon. Written comments on the proposal must be postmarked by Aug. 28, he said.

There were some form letters, Rabe said, but most - both pro and con - "were voicing their own thoughts on the issues." He has been in office since 1989 and can't recall any other issue generating so many written comments.

Those comments will go to the county's land use committee, which will review them and hear testimony before making a recommendation to the county board.

A transcript of the public hearing on the landfill proposal is available for review at Rabe's office at the courthouse in Chester; his staff will make copies of the document at 25 cents per page. He suggested people look over portions of the document, which is indexed, and copy only those portions they want.

"What I've asked is that they pick out the pages in person," Rabe said. "We don't have the time to research individual pages for phone requests."

Ron Stork, county board chairman, said he wouldn't comment on the proposal until he has received the recommendation of the land use committee and reviewed the hearing testimony and written comments from the public. He didn't attend the land use committee's hearing on the plan because he felt his presence might tend to inhibit comments from county residents.

With another huge landfill already being built near Marissa, FORCE fears that Land and Lakes also would seek customers from faraway states and bring in industrial waste. Talk of building a rail spur to the site increased those fears, Weber said.

The proposed landfill, he said, would have a capacity of 35 million cubic yards of trash, but that would be trash compacted to one-third its volume. Based on that, Weber said, about 105 million cubic yards of trash would be trucked in to the site, then compressed.

FORCE's goal, he said, "Is to get a bunch of information to the voters and taxpayers of the county. The general public, when they find out what's going on, they're against it."

Some candidates for the Randolph County Board already have come out against the proposal, he said.

Land and Lakes' local attorneys are Alan Farris and James Kelley. FORCE spokesmen noted that Farris also serves as the Sparta city attorney.

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The Issue:

The Player & Position	Belief Statement(s)	Value(s)

Activity 11: Research Question and Opinionnaire or Questionnaire

Part 1: From the Randolph County landfill article used in Activity 10, develop a possible issue investigation research question and identify it below.

Research Question:

Part 2: Based on the research question you developed in Part 1 above, generate three opinionnaire or questionnaire items below.

Question 1:

Question 2:

Question 3:

Activity 12: Selecting a Systematic Sample

Below is a list of 100 numbers. Pretend that this is a listing of telephone numbers of 100 people in a small town. Following the list, identify two different samples of ten people each that were selected systematically. After identifying the people in each sample, explain the system you used to select them.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Sample 1:

What system did you use to select this sample?

Sample 2:

What system did you use to select this sample?

Activity 13: Calculating Percentages

Graphing is one good way to communicate data. A graph makes understanding easier by presenting a "picture" of the data. Details are not lost because they can be interpreted from the graph. There are many graphing rules and procedures. Due to space constraints they will not be discussed here. However, an example will be presented which is typical of the kind of data that might be collected and graphed as a result of an MSW issue investigation. The sample question below is a "forced response" item using what is called a Likert Scale. The responses on this Likert Scale range from **0 = "to no extent"** to **4 = "to a great extent."**

Question No. 1 from the questionnaire: To what extent do you believe that Fisher County should develop a new materials reclamation facility?

0	1	2	3	4
No Extent	Little Extent	Moderate Extent	Large Extent	Great Extent

Now, let's pretend that data were systematically collected from 100 adults in Fisher County. Forty-one people chose "No Extent;" 33 selected "Little Extent;" 19 chose "Moderate Extent;" 7 chose "Large Extent;" and none chose "Great Extent."

Using Percentages

A graph will let us compare these different responses. For greater ease in understanding comparisons, many researchers prefer to compare percentages rather than comparing actual numbers. If you have not studied percentages, or if you have trouble calculating percentages, your teacher or perhaps another student can help you.

Percentages are easy to calculate. To find the percent of people who chose each response, just divide the number of people who chose a specific response (41 people chose "No Extent") by the total number of people in the sample (100 people). Here is a display of this technique:

41 ÷ 100 = .41 or 41% chose "No Extent."

Please calculate the percentages of people who chose the answers to Question No. 1.

No Extent: 41 ÷ 100 = 41%

Little Extent: 33 ÷ 100 = _____ %

Moderate Extent: _____ ÷ 100 = _____ %

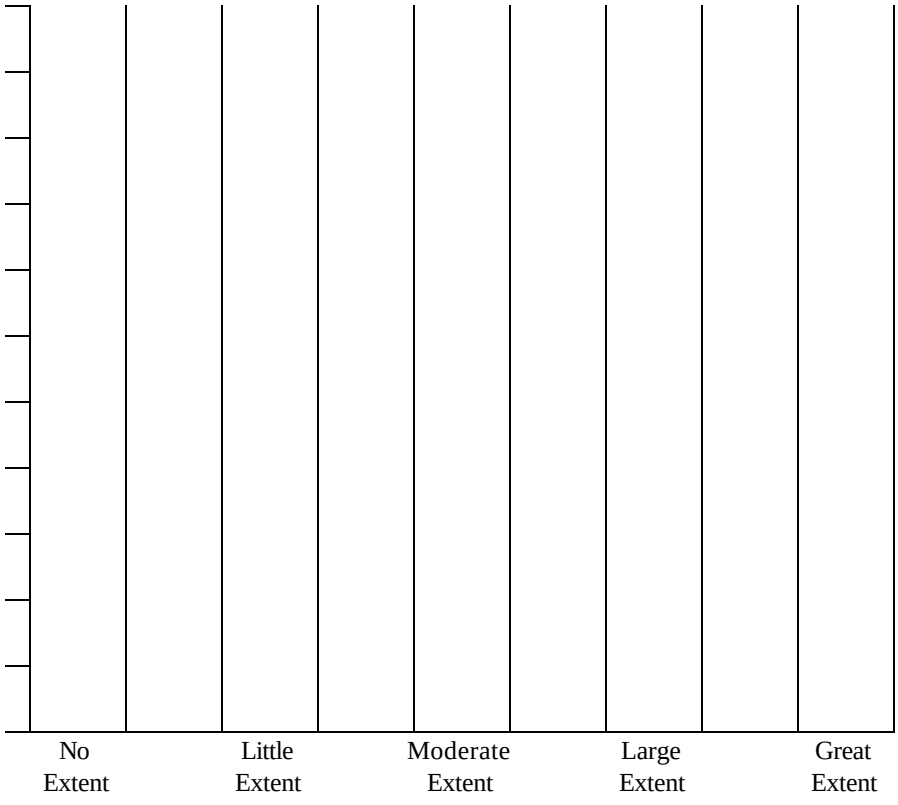
Large Extent: 7 ÷ _____ = _____ %

Great Extent: 0 ÷ 100 = 0 %

Activity 14: Making a Bar Graph

Now you are ready to graph the results from Activity 13. To do this you will need to use the percentages you calculated for each of the five responses to Question No. 1. Please complete the graph by plotting the percentages of Fisher County adults who selected "No Extent," "Little Extent," "Moderate Extent," "Large Extent," and "Great Extent."

1. To what extent do you believe that Fisher County should develop a new materials reclamation facility?



Activity 15: Conclusions, Inferences and Recommendations

A simplified, fictitious issue investigation outline follows.

Research Question: To what extent do Kankakee County residents recycle solid waste?
Population: Kankakee County Residents
Sample: 300 systematically sampled Kankakee County Residents

Questionnaire Question: To what extent do you recycle solid waste?

To No Extent	_____
To A Moderate Extent	_____
To A Great Extent	_____

Data From Sample: (One hundred responses)

To No Extent	60
To A Moderate Extent	195
To A Great Extent	45

1. Please write your conclusion for this question:

2. Please write an inference based on your conclusion:

3. Please write one recommendation that follows logically from your inference:

Activity 16: Planning an Issue Investigation

1. What MSW **topic** has been chosen for investigation? _____

2. What specific MSW **issue** has been selected as the focus of this investigation? _____

3. What are the **research questions** related to this issue? _____

4. Exactly what **information** will the instrument used in this investigation collect? That is, what are the variables of the study? _____

5. Is the **instrument** to be a . . . .

   _____ questionnaire; _____ opinionnaire; or _____ combination?

6. In what **geographical area** will the data collection take place?

7. If this is to be a questionnaire, opinionnaire, or combination instrument. . .

   A. What is the exact **population** from which data are to be collected?

   B. **How large should the sample be** in order to represent the population? _____

   Please explain. _____

C. How will you go about **selecting the sample**? _____

_____

_____

D. What **data collection method** will be used, e.g., telephone survey, mail survey, etc.?

_____

8. If this is to be an opinionnaire, what are the exact **beliefs and/or opinions** being investigated? _____

_____

_____

_____

9. If this is to be a questionnaire, what are the **facts or knowledge** that need to be identified and assessed? _____

_____

_____

_____

10. What are the exact **procedures** necessary to collect data with this instrument? That is, who will collect the data? How will it be recorded? During what periods of time will it be collected?

_____

_____

_____

11. How can the instrument be **trial tested and revised** before actual data collection?

_____

_____

12. How can the data be **recorded and organized** in a data summary sheet? _____

_____

_____

13. What are the **secondary sources of information**, e.g., experts, agencies, periodicals, etc.?_____

_____

MUNICIPAL SOLID WASTE AND THE 4Rs

CHAPTER 4

Citizenship Action

Learner Objectives for Chapter 4

Upon completing the material in Chapter 4, students should be able to . . .

1. . . . Define and provide an example of the following methods of citizenship action:
    a. Persuasion
    b. Consumer action
    c. Political action
    d. Physical intervention, also known as "ecomanagement."
2. . . . Identify the advantages of group action as compared to individual action.
3. . . . Review the information collected during the issue investigation (Chapter 3) and make recommendations regarding the solution of the issue based on that information.
4. . . . Analyze the proposed solution with respect to its consequences (ecological, economic, social, etc.).
5. . . . Identify the most desirable solution in view of the solution analysis.
6. . . . Produce and defend a list of citizenship actions which might be appropriate for helping to bring about the desired solution.
7. . . . Select a particular citizenship action, and working with a small group, evaluate the appropriateness of that action with respect to:
    a. The action's effectiveness
    b. The action's legal, economic, ecological consequences, etc.
    c. The action's potential for success based on the students' personal and group resources and skills.

Students and Citizenship Action: An Introduction

Are students willing to help solve MSW issues? If given the skills, would students be willing to get involved as responsible citizens. There is evidence all over the United States to indicate that the answer is a resounding "Yes"!!!

But, let's be cautious before we dive into **citizenship action**. Most students do not know how to take the citizenship actions necessary to help solve MSW issues. This may also be true for many adults. Many citizens have little knowledge of (and less practice with) the skills involved in issue resolution. Students who have been successful in issue solution have all been **trained in the use of citizenship action**. So, before a citizen can take responsible action, he or she must obtain some basic information about how issues are solved. Let's begin with a list of principles about a citizen's role in a democratic society.

1. A citizen has the right to be heard and to act on MSW issues.
2. A citizen has the responsibility to exercise citizenship rights and to be knowledgeable and skilled in such actions.
3. The law mandates some actions, but most involve one's own choice.
4. A citizen has the ability to investigate MSW issues and to obtain information on which that person can base a plan of action.
5. Most of the actions that you take in your life have consequences (environmental, economic, social, and others). You have the responsibility to consider whether an action will be positive or negative over the long run.
6. You have the ability to become skilled in at least some of the methods of citizenship action.

Every citizen needs to understand that it is every person's responsibility to participate in issue resolution. And, it is very important to understand that every individual has rights as a citizen, which help a person take action. Now let's look at the general methods of taking action to help resolve issues.

Two middle school students in Carbondale, Illinois, noticed the large number of abandoned cars in a neighborhood near their school. For an issue investigation they carefully surveyed the area and determined the number and type of vehicles there. On their own they visited the local police station and complained loudly about one noxious car in particular. The police got so tired of seeing the boys in the station they disposed of the car. After removing the car, the police informed the boys' science teacher, Mr. Litherland (who had known nothing of their complaints), that they had towed "his car" to the salvage lot. Needless to say the teacher spent a few breathless moments before realizing that it was not "his car" but one involved in the boys' issue investigation.

Modes of Citizenship Action

PERSUASION: Persuasion is the act of trying to convince a person (or a group of persons) that a certain action is the correct one. Logical appeals such as discussion, letter writing, and posters are the most positive approach to persuasion. However, emotional appeals and coercive efforts are also common types of persuasion.

CONSUMER ACTION: Consumer action is the act of buying (or not buying) a product or service. This action relies on the economic power of purchasing (to support) or **boycotting** (not support) certain ideas held by producers, manufacturers, agencies, legislatures, or even nations. Direct boycotting, indirect boycotting, and consumer conservation are types of consumer action.

POLITICAL ACTION: Political action refers to any action that brings pressure on political and/or government agencies (and their representatives) in order to persuade them to take a certain action. Voting, campaigning, and lobbying are common types of political action.

PHYSICAL INTERVENTION: Physical intervention (ecomanagement) is simply a phrase that refers to a physical action taken to help improve the status of an issue. For example, plastic litter that might prove dangerous to marine mammals can be reduced by a clean-up campaign.

Still True Today!

Parts of the earth, once living and productive, have thus died at the hand of man. Others are now dying. If we cause more to die, nature will compensate for this in her own way, inexorably, as already she has begun to do.

Fairfield Osborn in 1948

Some Examples of Municipal Solid Waste Actions Available to Middle and Secondary School Students

I. Persuasive Actions

a. Write "Letters to the Editor" for local and regional newspapers on MSW issues.
b. Write a special Guest Editorial for a local or regional newspaper on an important MSW issue.
c. Present issue investigation data to local environmental or civic groups.
d. Present action recommendations based on actual investigations at appropriate public hearings.
e. Present an educational program on MSW issues to a school or civic group.
f. Keep TV stations informed of news stories dealing with MSW issues.
g. Organize a community educational program on plastic or glass recycling awareness or other poorly understood MSW issues.
h. Distribute posters dealing with the effect of certain litter on wildlife or the benefits of recycling.

II. Consumer Action

a. Reduce consumption of products when possible.
b. Avoid one-use, disposable items.
c. Join a responsible environmental or other civic organization.
d. Use your own bags/containers when purchasing groceries.
e. Boycott products produced by environmentally irresponsible corporations.
f. Avoid buying products that are sold in extravagant disposable packaging.
g. Buy in bulk and buy durable products to minimize waste.
h. Support manufacturers and retailers who use a significant amount of post consumer recycled content by buying their products.
i. Buy products produced by environmentally responsible corporations.

III. Political Action

a. Ask adults to vote for environmentally responsible candidates for organizational offices.
b. Ask adults to vote for environmentally responsible candidates for political office.
c. Request governmental agencies to pass and enforce stricter regulations on community and highway litter.
d. Ask law enforcement agencies to pay closer attention to littering and illegal dump sites.
e. Write to legislators urging appropriate positions on political issues related to MSW.
f. Meet with community officials to present the results of issue investigations and ask for appropriate environmental action.

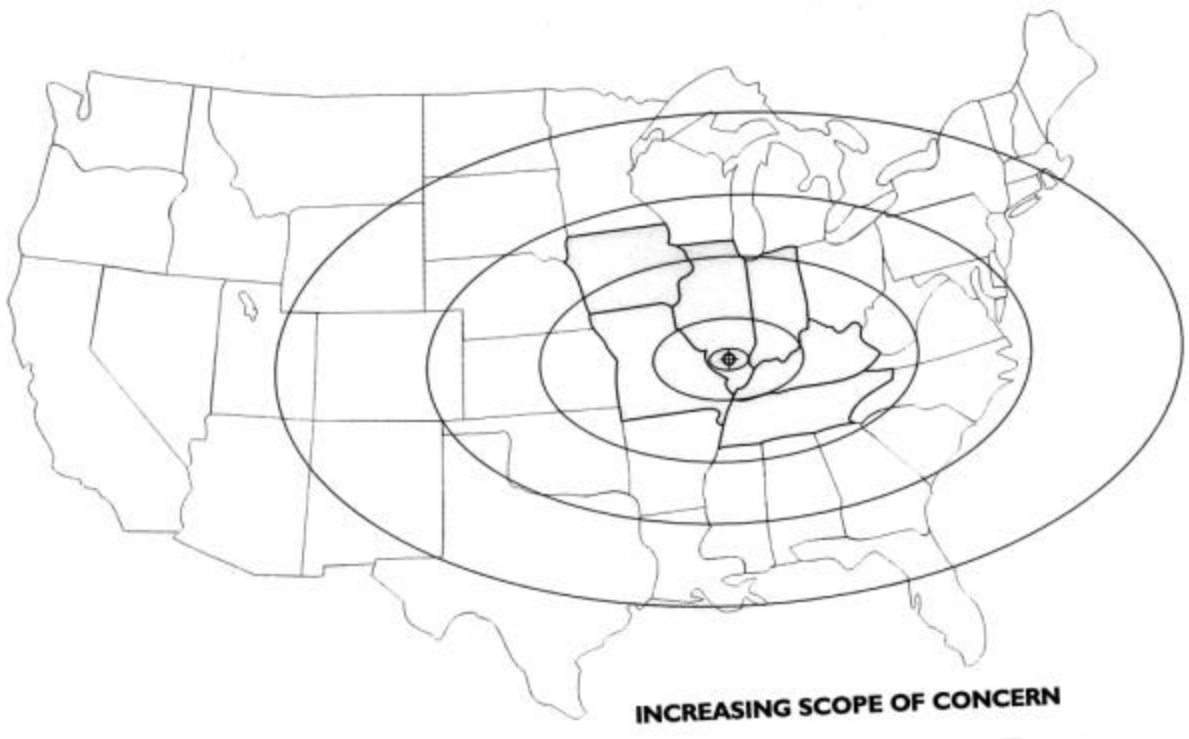
IV. Ecomanagement

a. Practice source reduction to reduce the waste generated, for example, 2-sided copying.
b. Set up and maintain a community or school recycling center for collecting and sorting recyclables.
c. Set up and maintain an in-school recycling program.
d. Organize and help direct a short-term community anti-litter campaign.
e. Contribute to environmental organizations that intervene positively in MSW issues.
g. Recycle and buy recycled products.
f. Set up and maintain a school composting program.
g. Volunteer to help local recycling drives or clean-up efforts.

Levels of Citizenship Action

Each of the action methods described earlier might be put into action in two ways: 1) by individual action, and 2) by group action. Individual involvement in issues is important. There are numerous examples of individuals, acting alone, bringing about the resolution of an issue. Generally, though, it is true that well-organized groups have more power for effective action. The diagram which follows shows how the scope of an action's effect increases as the size of the organization increases, i.e., actions range from individual to national in scope.

Levels of Environmental Action and Decision Making: Both Individual and Organizational



Examples of Increasing Scope and Concern

Individual Actions • Ecomanagement • Persuasion • Consumer Action • Political Action • Legal Action	**School Organizations** School Ecology Club	**State Agency** Illinois DCCA
	City or Local Agency Local Izaak Walton League	**Regional Affiliate of a National Agency** Regional EPA Office
Informal Groups Neighborhood Coalitions	**Area or County Affiliate** Regional Audubon Society	**National Organization** Steel Recycling Institute

Planning for Action

You and/or your class have now completed an investigation of a MSW issue. Hopefully, you used good scientific processes and learned a lot about the issue. You might also have become interested and personally involved in that issue. Often, when you know a lot about something, you **care** about it. And when you know and care about it, you're willing to do something! That's where we are now . . . it may be time for action!

The example that follows provides an opportunity to view an "action plan" for the recycling issue presented in Chapter 3. It illustrates a thoughtful plan, the intent of which is to help find a solution to the issue. *Activity 17*, found at the end of this chapter, provides a blank copy of this action plan form.

Part I. Identifying a Solution

1. Name of the issue. A recycling program for Murphydale, Illinois.
2. Your position and beliefs regarding this issue. Murphydale needs a recycling program to reduce solid waste going to the landfill and to help meet the mandated 25 percent county-wide recycling rate.
3. The solution which you propose. A voluntary, curbside pickup program in Murphydale which collects glass, plastic, steel and aluminum cans, newspaper, and cardboard.
4. What action or set of actions have you chosen as the most effective way to help resolve this issue? Political persuasion aimed at the Murphydale mayor and City Council.

Part II. Action Analysis Criteria

1. To what extent is there sufficient evidence to warrant action on this issue? The results from our issue investigation show overwhelming support from Murphydale residents for a voluntary, curbside pickup recycling program.
2. To what extent is this action the most effective one available? Since the program is a local one, the most logical place to start would seem to be with local officials.
3. What are the legal consequences of this action? None for residents, since the program would be a voluntary one.
4. What are the social consequences of this action? It may bring Murphydale community members closer together in common action to recycle and therefore reduce solid waste going to the landfill.
5. What are the economic consequences of this action? Probably will cost the community some money depending on markets for the recyclables, but will create a few new local jobs.
6. What are the ecological consequences of this action? Beneficial for the environment because less land will be needed for landfilling as the amount of solid waste decreases, and less energy and pollution is created by using recycled materials to make new products..
7. To what extent do my personal values support this decision? Personal environmental values support the plan 100 percent.

8. What are the beliefs and values of others involved in this decision? Most residents seem to support all parts of the recycling plan except for collecting aluminum. Based on their economic values, they may want to sell their aluminum.

9. Do I understand the procedures necessary to take this action? Yes _____ No _____
Comment: We have to look into the protocols for requesting meetings with the mayor and the City Council.

10. Do I have the skills needed to take this action? Yes ____ No _____

11. Do I have the courage to take this action? Yes ____ No _____

12. Do I have the time needed to complete this action? Yes ____ No _____

13. Do I have the other resources needed to do this action effectively? Yes ____ No _____

Part III. The Decision - Your Action Recommendation

Taking into account the analyses you have just completed, state your final recommendations for action. That is, what is your plan? Will you try to complete it?

All recommendations are based on our issue investigation data which show Murphydale residents favoring a voluntary, curbside pickup recycling program which collects glass, plastic, steel ans aluminum cans, newspaper, and cardboard. We will make an appointment with the mayor of Murphydale to enlist his support for a recycling program for the town. We will also schedule a time slot for the next City Council meeting to present our issue investigation data in an attempt to set the wheels in motion to implement a city-wide, voluntary, curbside pickup. The City Council needs to finalize plans for the recycling program and appoint a task force to get the program underway.

Activity

Objective for Chapter 4 Activity

After completing an issue investigation, the student will generate and systematically analyze an appropriate action plan based on the results of the investigation (see *Activity 17* on the following pages).

Here we see volunteers cleaning up an illegal dump in a wetland along an Illinois highway. What kind of action plan might you develop to get rid of a similar dump and, at the same time, keep the site free of waste disposal in the future

Activity 17: Planning for Action

Part I. Identifying a Solution

1. Identify the issue. _____

_____

2. Your position and beliefs regarding this issue. _____

_____

3. The solution which you propose. _____

_____

4. What action(s) have you chosen as the most effective way to help resolve this issue?

_____

_____

_____

Part II. Action Analysis Criteria

1. To what extent is there sufficient evidence to warrant action on this issue? _____

_____

_____

2. To what extent is this action the most effective one available? _____

_____

_____

3. What are the legal consequences of this action? _____

_____

_____

4. What are the social consequences of this action? _____

_____

_____

5. What are the economic consequences of this action? _____

_____

_____

6. What are the ecological consequences of this action? _____

_____

_____

7. To what extent do my personal values support this decision? _____

_____

_____

8. What are the beliefs and values of others involved in this decision? _____

_____

_____

9. Do I understand the procedures necessary to take this action? Yes _____ No _____.

10. Do I have the skills needed to take this action? Yes _____ No _____.

11. Do I have the courage to take this action? Yes _____ No _____.

12. Do I have the time needed to complete this action? Yes _____ No _____.

13. Do I have the other resources needed to do this action effectively? Yes _____ No _____.

Part III. The Decision - Your Action Recommendation

Taking into account the analyses you have just completed, state your final recommendations for action. That is, what is your plan? Will you try to complete it?

MUNICIPAL SOLID WASTE AND THE 4Rs

Appendices

Appendix A: Illinois Learning Standards, and Applications of Learning

Appendix B: Glossary of Terms

Appendix C: A Sampling of Readings for Middle School Students and Teachers

Appendix D: Using the Internet as an Information Resource

Appendix E: Government Agency Information Resources on Waste-Related and Environmental Issues

Appendix A
Illinois Learning Standards, and Applications of Learning

Illinois Learning Standards

State Goal	Standards
Language Arts and Reading	
1: Read with understanding and fluency.	A. Apply word analysis and vocabulary skills to comprehend selections. B. Apply reading strategies to improve understanding and fluency. C. Comprehend a broad range of reading materials.
2: Read and understand literature representative of various societies, eras and ideas.	A. Understand how literary elements and techniques are used to convey meaning. B. Read and interpret a variety of literary works.
3: Write to communicate for a variety of purposes.	A. Use correct grammar, spelling, punctuation, capitalization and structure. B. Compose well-organized and coherent writing for specific purposes and audiences. C. Communicate ideas in writing to accomplish a variety of purposes .
4: Listen and speak effectively in a variety of situations.	A. Listen effectively in formal and informal situations. B. Speak effectively using language appropriate to the situation and audience.
5: Use the language arts to acquire, assess and communicate information.	A. Locate, organize, and use information from various sources to answer questions, solve problems and communicate ideas. B. Analyze and evaluate information acquired from various sources. C. Apply acquired information, concepts and ideas to communicate in a variety of formats.
Math	
6: Demonstrate and apply a knowledge and sense of numbers, including numeration and operations (addition, subtraction, multiplication, division), patterns, ratios and proportions.	A. Demonstrate knowledge and use of numbers and their representations in a broad range of theoretical and practical settings. B. Investigate, represent and solve problems using number facts, operations (addition, subtraction, multiplication, division) and their properties, algorithms and relationships. C. Compute and estimate using mental mathematics, paper-and-pencil methods, calculators and computers. D. Solve problems using comparison of quantities, ratios, proportions and percents.
7: Estimate, make and use measurements of objects, quantities and relationships and determine acceptable levels of accuracy.	A. Measure and compare quantities using appropriate units, instruments and methods. B. Estimate measurements and determine acceptable levels of accuracy. C. Select and use appropriate technology, instruments and formulas to solve problems, interpret results and communicate findings.

State Goal	Standards
8: Use algebraic and analytical methods to identify and describe patterns and relationships in data, solve problems, and predict results.	A. Describe numerical relationships using variables and patterns. B. Interpret and describe numerical relationships using tables, graphs and symbols. C. Solve problems using systems of numbers and their properties. B. Use algebraic concepts and procedures to represent and solve problems.
9: Use geometric methods to analyze, categorize and draw conclusions about points, lines, planes and space.	A. Demonstrate and apply geometric concepts involving points, lines, planes and space. B. Identify, describe, classify and compare relationships using points, lines, planes and solids. C. Construct convincing arguments and proofs to solve problems. D. Use trigonometric ratios and circular functions to solve problems.
10: Collect, organize and analyze data using statistical methods; predict results; and interpret uncertainty using concepts of probability.	A. Organize, describe and make predictions from existing data. B. Formulate questions, design data collection methods, gather and analyze data and communicate findings. C. Determine, describe and apply the probabilities of events.
Science	
11: Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems.	A. Know and apply the concepts, principles and processes of scientific inquiry. B. Know and apply the concepts, principles and processes of technological design.
12: Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences.	A. Know and apply concepts that explain how living things function, adapt and change. B. Know and apply concepts that describe how living things interact with each other and with their environment. C. Know and apply concepts that describe properties of matter and energy and the interactions between them. D. Know and apply concepts that describe force and motion and the principles that explain them. E. Know and apply concepts that describe the features and processes of the Earth and its resources. F. Know and apply concepts that explain the composition and structure of the universe and Earth's place in it.
13: Understand the relationships among science, technology and society in historical and contemporary contexts.	A. Know and apply the accepted practices of science. B. Know and apply concepts that describe the interaction between science, technology and society.

State Goal	Standards
Social Studies	
14: Understand political systems, with an emphasis on the United States.	A. Understand and explain basic principles of the United States government. B. Understand the structures and functions of the political systems of Illinois, the United States and other nations. C. Understand election processes and responsibilities of citizens. D. Understand the roles and influences of individuals and interest groups in the political systems of Illinois, the United States and other nations. E. Understand United States foreign policy as it relates to other nations and international issues. F. Understand the development of United States political ideas and traditions.
15: Understand economic systems, with an emphasis on the United States.	A. Understand how different economic systems operate in the exchange, production, distribution and consumption of goods and services. B. Understand that scarcity necessitates choices by consumers. C. Understand that scarcity necessitates choices by producers. D. Understand trade as an exchange of goods or services. E. Understand the impact of government policies and decisions on production and consumption in the economy.
16: Understand events, trends, individuals and movements shaping the history of Illinois, the United States and other nations.	A. Apply the skills of historical analysis and interpretation. B. Understand the development of significant political events. C. Understand the development of economic systems. D. Understand Illinois, United States and world social history. E. Understand Illinois, United States and world environmental history.
17: Understand world geography and the effects of geography on society, with an emphasis on the United States.	A. Locate, describe and explain places, regions and features on the Earth. B. Analyze and explain characteristics and interactions on the Earth's physical systems. C. Understand relationships between geographic factors and society. D. Understand the historical significance of geography.
18: Understand social systems, with an emphasis on the United States.	A. Compare characteristics of culture as reflected in language, literature, the arts, traditions and institutions. B. Understand the roles and interactions of individuals and groups in society. C. Understand how social systems form and develop over time.

Applications of Learning

Applications of learning are significant methods of learning and using knowledge, which cross academic disciplines. The ability to use these skills will greatly influence students' success later in life. The five applications of learning are explained below:

Solving Problems - Problem solving is a key mechanism in which students learn to investigate problems and to formulate and propose solutions supported by reason and evidence.

Communicating - Understanding lessons is only the beginning of education. Students also must be able to express and receive information and ideas accurately and clearly in oral and written forms. In fact, communication reinforces learned lessons, helping students to use facts and information to build further knowledge.

Using Technology - Technology, particularly telecommunications and computer technology, puts a wealth of information and expertise at students' fingertips. Skilled use of technology creates a gateway to relevant, up-to-date information well beyond the walls of the classroom.

Working on Teams - Learning is an intensely individual activity, but students also need to know how to contribute as members of teams or work groups. This aspect of learning is essential to adult life.

Making Academic Connections - Every subject is related in some fashion to others. Students must learn to place information within a larger setting in order to see the connections among lessons, subjects and everyday life.

APPENDIX B
GLOSSARY OF TERMS

Aerobic: something that lives in or happens in the presence of oxygen; requiring the presence of air or free oxygen.

Aluminum: a lightweight metal made from an ore called bauxite.

Anaerobic: something that lives in or happens in the absence of oxygen.

Atmosphere: typically thought of as the air that surrounds the earth.

Belief: that which a person holds to be true.

Biodegradable: any materials that can be broken down or decomposed by the natural organisms in the environment, e.g., paper products, human sewage, and vegetable matter.

Boycott: to abstain from purchasing or using.

Carcinogen: something capable of causing cancer.

Centralized resource recovery: process in which collected recyclable materials are taken to a central location to be processed.

Citizenship action: the skills of persuasion, consumer action, ecomanagement, legal action and economic action that are used to help solve environmental issues.

Composting: the process of providing an environment for the rapid decomposition of organic debris such as leaves and vegetable wastes in order to produce material that can be used as humus or fertilizer.

Conservation: the preservation of natural resources.

Consumer: 1) an organism that gets it nutrients by preying on other organisms (ecology). Consumers may be a) *primary* - eating producers, b) *secondary* - preying on primary consumers, or c) *tertiary* -preying on secondary consumers. 2) someone who buys products or services (economics).

Cullet: recovered glass that has been ground or crushed and cleaned in preparation for remelting and recycling.

DCEO: abbreviation for the **D**epartment of **C**ommerce and **E**conomic **O**pportunity.

Decomposition: the process of breaking down or rotting; decay.

Dioxins: a family of chlorinated hydrocarbons, many of which are known health hazards.

Dirty MRF: a materials reclamation facility in which unseparated MSW is processed to recover recyclables.

Dump, illegal: open, unsanitary disposal site; to throw away garbage or solid waste in an unsuitable place.

Energy: the ability to do work; energy may take many forms including mechanical, electrical, chemical, nuclear or thermal, among others.

Environment: biotic and abiotic factors which surround an organism, often used with reference to human beings, and which impact in some manner on that organism.

Environmental impact assessment: an evaluation of the extent to which certain activities will negatively impact/influence the environment.

Environmental issue: a problem with obvious environmental overtones surrounding which one can observe differing human beliefs and values.

Fly ash: small particles of ash and soot produced when coal, oil, or waste materials are burned; fly ash is carried out of the flue of a furnace.

Furans: a group of heterocyclic organic compounds.

Garbage: discarded material; trash; unwanted solid waste; anything that people no longer want or use.

Groundwater: water that sinks into and through the soil to be stored underground; large underground storage areas are called aquifers.

Hazardous: dangerous to handle or dispose of; hazardous materials include substances that are toxic, flammable, corrosive, infectious or radioactive. Wastes such as old explosives or hospital wastes are classified hazardous.

Humus: dark organic material in soils; decayed vegetable and/or animal matter found in the soil.

Hydrocarbons: compounds of hydrogen and carbon; they are highly combustible and are used as fuels; they are found in oil, gas, and other fossil fuels.

Hydrochloric acid: term for a water solution of a simple compound of hydrogen and chlorine, HCl; hydrochloric acid is highly toxic and caustic.

IEPA: abbreviation for Illinois Environmental Protection Agency.

Incineration: the burning of something; often refers to a method of disposing of solid wastes in an incinerator.

Incinerator: a device for incineration; something in which solid waste is burned for the purpose of volume reduction or energy production.

Inorganic: not having the characteristics associated with animal or plant material; chemical compounds that are not hydrocarbons or their derivatives.

Integrated waste management: a recommended approach to solid waste management that involves the complementary use of source reduction, recycling and composting, incineration, and landfills.

Iron: a metallic element used for making tools, machinery, and other manufactured items.

Landfill: a place in which unwanted materials are disposed; also called sanitary landfill; wastes are deposited here and then compacted and covered with soil.

Leachate: a liquid that has percolated through solid waste and/or been produced by solid waste decomposition; a solution of dissolved solids such as soluble materials from soils or landfill components, carried downward by percolating ground water.

Legal action: any legal/judiciary action taken by an individual and/or organization which is aimed at some aspect of environmental law enforcement, or a legal restraint preceding some environmental behavior perceived as undesirable, e.g., law suits, injunctions.

Litter: rubbish/waste scattered about (here and there); littering is almost universally against the law.

Market: a place where products are sold; in recycling, the company that purchases recycled commodities for use in manufacturing new products.

Materials reclamation facility: a place where solid waste is processed for recovery of recyclables or where commingled recyclables are sorted and processed. (See: Dirty MRF)

Methane: colorless and odorless gas (CH_4); methane is often called "marsh gas."

MRF: abbreviation for materials reclamation/recovery/recycling facility.

MSW: abbreviation for municipal solid waste.

Municipal solid waste: waste within a community (see "solid waste").

Natural resources: resources that occur naturally such as forests, coal, oil, fish and soil.

Nutrient: any chemical that is needed by a plant or animal for growth and reproduction.

Organic: anything that was once part of a living plant or animal. May also refer to a class of chemical compounds containing carbon.

Packaging: container in which something is packed; a covering used to protect and/or promote a product.

Persuasion: an effort, verbally, to motivate human beings to take positive environmental action as a function of modified values, e.g., argumentation, debate, speech making, letter writing.

Plastic: a product made from synthetic or natural organic materials that may be shaped when soft and then hardened.

"Player" (in an issue): a person, group, or organization involved in an issue, having definite beliefs (and a particular position on the issue) and certain supporting values.

Pollutant: a chemical whose concentration has built up to the point where it harms human beings, other animals, or plants; pollutants can be found in air, water, soil, and other environments.

Pollution: introduction of harmful substances into the environment.

Population: the entirety of a group of people from which data are to be collected.

Position: the way a "player" would answer an issue question in an issue analysis.

Product life-cycle: the entire duration of a product from extraction of raw materials, manufacture, transportation, use, and disposal.

Recyclable product: a product that can be recovered and recycled after being used.

Recycle: to use over and over again; to recover products from waste so that the materials from which they are made can be used to make new products, or reused in some productive manner.

Recycled product: a product that is made from recycled material.

Reduce: to decrease the amount of solid waste generated that will need to be recycled or disposed. (see source reduction)

Renewable resource: a resource which can be replaced; usually calls for some sort of conservation program to assure a continued supply, e.g., water, timber, soil, fishes, etc.

Representative sample: a sample that is felt to have all of the characteristics of the population from which it was drawn.

Resource recovery: the process of recovering usable materials from waste.

Sample: a subset of a population selected in a research study.

Sanitary landfill: see "landfill."

Scrubber: a device for removing pollutants from smoke or gas produced by burning high-sulfur fuel.

Solid waste management: a strategy for collecting, controlling, handling, and disposing of solid waste.

Solid waste: materials thrown away and in need of disposal, not usually associated with wastes such as radioactive or toxic/chemical materials; often wastes with materials which could be recycled; waste products which are not gaseous or liquid.

Source reduction: eliminating waste at the source; producing less waste or decreasing its toxicity.

Source separation: the sorting of waste materials at the point of generation; removing and separating recyclable materials at home, in school, or in businesses.

Steel: a metal made of refined iron that contains less carbon impurities than raw iron; used for many manufacturing purposes and easily recycled.

Tipping fee: the fee charged at a disposal site to dump garbage; usually at a landfill.

Toxic materials: chemicals that can cause serious health problems - even death; also, some toxic materials have the ability to cause mutations or deformities in human beings.

Transfer station: a facility where solid waste is collected from local haulers for delivery to distant disposal sites.

Trash: waste material considered worthless, unnecessary or offensive; usually thrown away; garbage.

US EPA: abbreviation for United States Environmental Protection Agency.

Value, i.e., a value: an established ideal; a way of acting; the perceived worth of something, e.g., the perceived worth of wildlife.

Waste stream: the solid waste produced by people or industries within a given area, community, or facility.

Waste-to-energy: the process of burning waste to produce useful heat or electricity.

Appendix C
A Sampling of Readings for Middle School Students and Teachers

A Sampling of Readings for Middle School Students

America's Renewable Resources: Historical Trends & Current Challenges
by Kenneth Frederick. Washington, DC: Resources for the Future, 1991.

Compost Critters
by Bianca Lavais. New York, NY: Dutton Children's Books, 1993.

Compost!: Growing Gardens from Your Garbage
by Linda Glaser. Brookfield, CT: Millbrook Press, 1996.

Composting & Recycling Municipal Solid Waste
by Luis F. Diaz. Boca Raton, FL: Lewis Publishers, 1993.

Composting in the Classroom: Scientific Inquiry for HS Students
by Nancy Trautman. Dubuque, IA: Kendall/Hunt Publishers, 1998.

Earth Book for Kids
by Linda Schwartz. Santa Barbara, CA: The Learning Works, Inc., 1990.

Earth Right
by H. Patricia Hynes. Rocklin, CA: Prima Publishing & Communications, 1990.

Earthworms, Dirt, and Rotten Leaves
by Molley McLaughlin. New York, NY: Atheneum, 1986.

Easy Recycling Handbook: What to Recycle and How to Buy Recycled
by Dee McVicker. Gilbert, AZ: Grassroots Publishing, 1994.

Ecology Basics
by Lawrence Stevens. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1986.

The Envelope Mill: Recycle Magazines Into Beautiful, New Envelopes
by Haila Crowell. Summit Publishing Group, 1994.

The Environment: Distinguishing Between Fact and Opinion
by William Dudley. San Diego, CA: Greenhaven Press, Inc., 1989.

Environmental Science: 49 Science Fair Projects
by Robert L. Bonnet and G. Daniel Keen. Blue Ridge Summit, PA: Tab Books, Inc., 1990.

Fifty Simple Things Kids Can Do To Recycle
Earth Works Group Staff. Kansas City, MO: Andrews & McMeel, 1994.

Garbage! Where It Comes from, Where It Goes
by Evan Hadingham and Janet Hadingham. New York, NY: Simon and Schuster, Inc., 1990.

Gardens from Garbage: How to Grow Indoor Plants from Recycled Kitchen Scraps
by Judith F. Handelsman. Brookfield, CT: Millbrook Press, 1993.

Habitat Destruction
by Tony Hare. New York, NY: Gloucester Press, 1990.

How on Earth Do We Recycle Metal?
by Rudy Kouhoupt and Don Marti. Brookfield, CT: Millbrook Press, 1992.

How on Earth Do We Recycle Paper?
by Helen Jill Fletcher and Seli Groves. Brookfield, CT: Millbrook Press, 1992.

How on Earth Do We Recycle Plastic?
by Janet Potter D'amato and Laura Stephenson Carter. Brookfield, CT: Millbrook Press, 1992.

The Kids' Environment Book: What's Awry and Why
by Anne Pedersen. Santa Fe, NM: John Muir Publications, 1991.

Living in a Risky World!
by Laurence Pringle. New York, NY: Morrow Junior Books, 1989.

Recycle That!
by Fay Robinson. Chicago, IL: Children's Press, 1995.

Recycle with Earthworms: The Red Wiggler Connection
by Shelley C. Grossman and Toby Weitzel, Eagle River, WI: Shields Publications, 1997.

Save the Earth
by Betty Miles. New York, NY: Alfred A. Knopf, Inc., 1991.

Stop that Garbage Truck
by Linda Glaser. Morton Grove, IL: A. Whitman, 1993.

Tin Can Paper Making: Recycle for Earth & Art
by Arnold E. Grummer. Appleton, WI: Greg Markim, Inc., 1992.

Tons of Trash: Why You Should Recycle and What Happens When You Do
by Joan Heilman. New York, NY: Avon Camelot, 1992.

Water: The Next Great Resource Battle
by Laurence Pringle. New York, NY: Macmillan Publishing Co., 1982.

Who Really Killed Cock Robin?
by Jean Craighead George. New York, NY: Harper Collins Publishers, 1991.

Worms Eat My Garbage
by Mary Appelhof. Kalamazoo, MI: Flower Press, 1997.

A Sampling of Readings for Middle School <u>Teachers</u>

Denison, R., Ruston, J. & Taylor, J. (1998). Does recycling make economic sense? *CQ Researcher, 8*(12), 281.

The five most dangerous myths about recycling. (1996). [Online]. Available: http://grn.com/library/5

Glenn, J. (1998). The state of garbage in America. *BioCycle, 39*(4), 32-43.

Illinois solid waste recycling and composting. (1998). [Online]. Available: http://www.epa.state.il.us/land/recycle.html

Marxsen, C. (1997). What rubbish? *National Review*, 49(23), 32.

Recycling in Illinois. (1998). Oak Park, IL: Illinois Recycling Association. (This pamphlet may be obtained by calling 708/358-0050 or by writing to: Illinois Recycling Association, P.O. Box 3717, Oak Park, IL 60303-3717.)

Why Buy Recycled? (1998). Springfield, IL: Department of Commerce and Economic Opportunity. (This pamphlet may be obtained by calling 800/252-8955 in Illinois or (TDD) 800/785-6055, or by writing to: IL DCEO, Bureau of Energy and Recycling, 620 East Adams Street, Springfield, IL 62701.)

The Wonderful World of Wigglers
by Julia Hand. Montpelier, VT. Common Roots Press, 1995.

The Worm Cafe: *Mid-scale Vermicomposting of Lunchroom Wastes*
by Binet Payne. Kalamazoo, MI. Flower Press, 1999.

Worms are a Class Act!
by the Can-O-Worms Worm Farm. Maple Ridge, BC, Canada., Viscor Distribution, Inc., 1996.

Worms Eat Our Garbage: Classroom Activities for a Better Environment
by Mary Appelhof, Mary Frances Fenton, Barbara Loss Harris. Kalamazoo, MI: Flower Press, 1993.

Appendix D
Using the Internet as an Information Resource

The Internet is a tool that can provide you with many opportunities to locate and use current information about environmental issues and legislation. In the section below, you will find a few addresses for information sources on the Internet and the World Wide Web. These sources vary tremendously. Some of them will take you beyond MSW and into topics that are closely related to MSW, e.g., asphalt recycling.

You may want to try some these sources if you have access to the Internet. A word of caution, however. Many of these and other addresses tend not to be stable, that is, they disappear from the Internet or they change. Because of this, some of the addresses here might be out-of-date when you try to use them.

Also, you may want to use search engines to access enormous amounts of information about specific MSW topics and issues. Several search engines can be found on the Internet. Some examples are: Google (*www.google.com*), Dogpile (*www.dogpile.com*), Excite (*www.excite.com*) and Metacrawler (*www.metacrawler.com/index_power.html*).

CISDE Home Page -
http://hc3.netgate.net/cisde/

Contents

US Government Sites:

USEPA – Office of Solid Waste
http://www.epa.gov/epaoswer/osw/index.htm

USEPA/OSW - Municipal Solid Waste in the United States 1999 Facts and Figures
http://www.epa.gov/epaoswer/non-hw/muncpl/msw99.htm

Office of the Federal Environmental Executive
http://www.ofee.gov/

ILLINOIS Sites:

Illinois Department of Commerce and Economic Opportunity
http://www.illinoisbiz.biz/com/recycling/index.html

Illinois Recycling Association
http://www.ilrecyclingassn.org

Chicago Department of Streets and Sanitation
http://www.ci.chi.il.us/WorksMart/StreetsAndSan/

Chicago Recycling Initiative
http://www.cityofchicago.org/Environment/SolidWaste/RecyclingInitiative.html

Chicago Blue Bag Recycling
http://www.groot.com/welcome.htm

McHenry County Defenders
http://www.mcdef.org/

Other States' Sites:

California Integrated Waste Management Board
http://www.ciwmb.ca.gov/

Massachusetts Dept. of Environmental Protection
http://www.state.ma.us/dep/recycle/recycle.htm

Michigan Department of Environmental Quality
http://www.michigan.gov/deq

Minnesota Office of Environmental Assistance
http://www.moea.state.mn.us/reduce/index.cfm

Missouri Division of Environmental Quality
Air and Land Protection Division, Solid Waste Management Program
http://www.dnr.state.mo.us/alpd/swmp/homeswmp.htm

North Carolina Division of Pollution Prevention and Environmental Assistance
http://www.p2pays.org/

Northeast Recycling Council
http://www.nerc.org/

Ohio Department of Natural Resources
http://www.dnr.state.oh.us/recycling/default.htm

Pennsylvania Department of Environmental Protection
http://www.dep.state.pa.us/dep/deputate/airwaste/wm/RECYCLE/Recycle.htm

Pennsylvania Resources Council
http://www.prc.org/

Recycle Iowa
http://www.recycleiowa.org/

Link Sites:

About: Environmental Issues – Recycling
http://environment.about.com/newsissues/environment/cs/recycling1/index.htm

Environmental Organizations WebDirectory - Recycling
http://www.webdirectory.com/Recycling/

Global Recycling Network - Regional Recycling Resources
http://grn.com/grn/library/regional.htm

WWW Virtual Library
http://www.earthsystems.org/virtuallibrary/v/recycling.html

Industry Organizations:

Alliance of Foam Packaging Recyclers
http://www.epspackaging.org/

Aluminum Association, Inc.
http://www.aluminum.org

American Forest and Paper Association
http://www.afandpa.org/Content/NavagationMenu/Environment_and_Recycling/Recycling/Recycling.htm

American Metal Market
http://www.amm.com/index2.htm

American Plastics Council (recycling page)
http://www.plasticsresource.com/recycling/index.html

Buy Recycled Business Alliance (BRBA)
http://www.nrc-recycle.org/brba

Environmental Industry Associations - Interactive
http://www.envasns.org/

Foodservice & Packaging Institute - Environment
http://www.fpi.org/jahia/Jahia/pia/57

Glass Packaging Institute
http://www.gpi.org/Recycling.html

Institute of Scrap Recycling Industries
http://www.isri.org/

National Association for PET Container Resources (NAPCOR)
http://www.napcor.com

National Oil Recyclers Association
http://www.NoraNews.org

National Recycling Coalition
http://www.nrc-recycle.org/

Plastic Bag Association
http://www.plasticbag.com/

Plastic Loose Fill Council
http://www.loosefillpackaging.com/

Polystyrene Packaging Council
http://www.polystyrene.org/

Rechargeable Battery Recycling Corporation
http://www.rbrc.com/

Recycled Paper Coalition
http://www.papercoalition.org/

Society of the Plastics Industry
http://www.socplas.org/outreach/environment/

Steel Recycling Institute (SRI)
http://www.recycle-steel.org/index2.html

Service Provider Sites:

Entech, Inc.
http://www.4entech.com/index.html

Groot Recycling and Waste Services
http://www.groot.com/welcome.htm

Paper Trail, Inc.
http://www.papertrail.com/

Waste Management
http://www.wastemanagement.com/

Weyerhaeuser
http://www.weyerhaeuser.com/ourproducts/pulppaperpckging/recycling/

Kids/School Educational Sites:

About: Environmental Education – Recycling (link list)
http://environment.about.com/newsissues/environment/cs/recyclingedu/index.htm

British Metals Federation
http://britmetfed.org.uk/

California Department of Conservation, Recycle Rex page
http://www.consrv.ca.gov/DOR/ree/index.htm

Cornell Waste Management Institute –Youth Resources
http://www.cfe.cornell.edu/wmi/Youth.html

Environmental Organizations WebDirectory – education
http://www.webdirectory.com/Education/K-12/

IL Environmental Protection Agency– Kids Education
http://www.epa.state.il.us/education.html

Internet Guide to Recycling
http://www.libsci.sc.edu/bob/RECYCLE.HTM

John Lemmon films, Henry Cycle Campaign
http://www.jlf.com/henry.html

Los Angeles Learning Exchange
http://www.lalc.k12.ca.us/target/units/recycle/

Minnesota Office of Environmental Assistance
http://www.moea.state.mn.us/ee/index.cfm

NSTA Source Reduction Curriculum
http://www.use-less-stuff.com/

Pennsylvania Resources Council
http://www.prc.org/

Roscoe's Recycle Room (Steel Recycling Institute)
http://www.recycleroom.org/html/launch.html

USEPA – Explorers Club
http://www.epa.gov/kids/

Yuckiest Site on the Internet – Wendell's Worm World
http://yucky.kids.discovery.com/

College/University Sites:

College and University Recycling Council
http://www.nrc-recycle.org/councils/CURC/

Cornell Waste Management Institute
http://www.cfe.cornell.edu/wmi/default.html

Indiana Institute of Recycling
http://web.indstate.edu/recycle/

Michigan Tech, Institute of Materials Processing
http://www.imp.mtu.edu/sldwaste/sldwaste.html

University of Arizona – Garbage project
http://bara.arizona.edu/gs.htm

Materials Exchange/ Business Portal Sites:

Global Recycling Network
http://www.grn.com/

Recycle Exchange
http://www.recyclexchange.com/

Recycler's World
http://www.recycle.net/

Recycling.com
http://www.recycling.com/en/index.html

Recycling Containers:

Busch Systems International
http://www.busch-systems.com/index.html

Enviro Care of America
http://www.envirocare.net/

Fibrex
http://www.fibrexgroup.com/

Rehrig Pacific Company
http://www.rehrigpacific.com/

Tulip Corporation
http://www.tulipproducts.com/

Windsor Barrel Works
http://www.windsorbarrel.com/clusters.html

Electronics Recycling:

American Plastics Council
http://www.plasticsresource.com/recycling/other_resources/electronic_recycling.html

Electronic Industries Alliance
http://www.eiae.org/

Green Disk
http://www.greendisk.com/Default.htm

Industry Council for Electronic Equipment Recycling – U.K.
http://www.icer.org.uk/

International Association of Electronic Recyclers
http://www.iaer.org/

NRC Electronics Recycling Initiative
http://www.nrc-recycle.org/resources/electronics/index.htm

PEP National Directory of Computer Recycling Programs
http://www.microweb.com/pepsite/Recycle/recycle_index.html

System Service International (SSI)
http://www.ssisystem.com/

United Recycling Industries, Inc.
http://www.unitedrecycling.com/services/services.html

Recycled Product / Market Directories:

(see also Business portal sites):

American Plastics Council consumer's guide to recycled plastics
http://www.americanplasticscouncil.org/apcorg/classroom/mall/index.html

California Recyclestore
http://www.ciwmb.ca.gov/Recyclestore/default.asp

King Co., Washington Environmental Purchasing
http://www.metrokc.gov/procure/green/index.htm

Minnesota Recycled Products Directory
http://www.moea.state.mn.us/rpdir/index.cfm

Pennsylvania Recycled Products Manufacturers
http://www.dep.state.pa.us/dep/deputate/airwaste/wm/RECYCLE/paman/page1.html

Pennsylvania Resources Council – Recycled products directories
http://www.prc.org/rpdirect.htm

Recycled Data Management Corp. – Recycled Product Guide
http://www.recyclingdata.com/

Recycled Products Purchasing Cooperative
http://www.recycledproducts.org

Wisconsin Recycling Markets Directory
http://www.dnr.state.wi.us/org/aw/wm/markets/category.html

Recycled product shopping / promotional items:

Abundant Earth
http://www.abundantearth.com/

Acorn Designs
http://www.acorndesigns.org/

Amazing Recycled Products
http://www.amazingrecycled.com/

Aurora Glass
http://www.auroraglass.org/

BikeGames Industries
http://www.bikegames.com/

Discover The World – reflyer Frisbee
http://www.dtworld.com/recreational%20products.htm

Earth Fashions
http://www.earthfashions.com/

Earthsystems.org virtual shopping center
http://www.earthsystems.org/vsc_index.html

Eco Goods
http://www.ecogoods.com/

Ecomall
http://www.ecomall.com/

Ethical Shopper
http://www.gaiam.com/greenmarket/

Glass Garden Design
http://www.glassgardendesign.com/

Green Disk
http://www.greendisk.com/Default.htm

Green Market Place
http://www.gaiam.com/greenmarket/

Greenweave Environmental Apparel
http://www.greenweave.com/

Inkjet Domain - Jetpak
http://www.inkjetdomain.com/

Motherboard, Inc.
http://www.motherboardinc.com

Planet Natural
http://www.planetnatural.com/

PlasTEAK – plastic lumber products
http://www.plasteak.com

Proform Technologies, Inc. - bedliners
http://www.proliner.com/

Recycled Store
http://www.recycledstore.com/

Recycline (toothbrushes)
http://www.recycline.com/

Re-Sails – clothing, etc from sails
http://www.resails.com/

The Plastic Lumber Co.
http://www.plasticlumber.com/

Signature Marketing
http://www.signaturemarketing.com/index1.htm

Stan Miller and Associates
http://www.millerpromotions.com/

Used Rubber USA
http://www.usedrubber.com/

Weisenbach Specialty Printing
http://www.weisenbach.com/

Manufacturer Sites:

Envirobag – School recycling program
http://www.envirobag.com/

Georgia Pacific Papers
http://www.gp.com/paper/recycled.html

House of Doolittle
http://www.houseofdoolittle.com/

ITW Hi-Cone (Ringleader program)
http://www.ringleader.com/quest/menu/program/index.html

Lakin Tire
http://www.lakintire.com/

Mohawk Paper Mills
http://www.mohawkpaper.com/main/?library/basics/topics/?green_seal.ehtml

Smurfitt-Stone Container Corporation
http://www.smurfit-stone.com/

Wellman, Inc.
http://www.wellmaninc.com/

Green Building Materials:

BauBuilder
http://www.baubuilder.com/

Castleblock
http://www.castleblock.com/

Collins & Aikman Floorcoverings
http://www.powerbond.com/

DecorCable Innovations – Polyal surface materials
http://www.decorcable.com/SPECIALTIES/Polyal.htm

Government Sales Associates L.C.
http://www.governmentsales.com/

Interface, Inc – Flooring
http://www.interfaceinc.com/us/

Polywood, Inc.
http://www.polywood.com/

TerraTex Fabrics
http://www.terratex.com/home.html

To Market
http://www.tomkt.com/

TREX
http://www.trex.com/

US Plastic Lumber Corp.
http://www.usplasticlumber.com/

Weather-Bos Paints and Finishes
http://www.weatherbos.com/

Yemm & Hart Green Materials
http://www.yemmhart.com/

News:

About: Environmental Issues – Recycling News
http://environment.about.com/newsissues/environment/library/weekly/blenews1.htm

Environmental News Network
http://www.enn.com/

Planet ARK - *Reuters Daily World Environment News*
http://www.planetark.org/index.cfm

Recycling Policy News
http://www.raymond.com/

Recycling Today
http://www.recyclingtoday.com/

Recycling World Magazine (U.K.)
http://www.tecweb.com/recycle/rwcont.htm

Waste News
http://www.wastenews.com

Composting Sites:

Biocycle
http://www.jgpress.com/

Composting Council of Canada
http://www.compost.org/englishoverview.html

Cornell – Composting in Schools
http://www.cfe.cornell.edu/compost/schools.html

Refuse/Environmental Systems - Composting
http://www.resystems.com/compost.html

US Composting Council
http://compostingcouncil.org/

Misc:

About: Environmental Issues
http://environment.about.com/newsissues/environment/cs/recycling1/index.htm

America Recycles Day
http://www.americarecyclesday.org/

Chelsea Center for Recycling and Economic Development
http://www.chelseacenter.org/

Clean Washington Center
http://www.cwc.org/

Earth's 911
http://www.1800cleanup.org/

Earthsystems.org
http://www.earthsystems.org/

Envirolink network
http://www.envirolink.org/

Environmental Defense
http://www.environmentaldefense.org/

Institute for Local Self-Reliance
http://www.ilsr.org/recycling/index.html

Internet Consumer Recycling Guide
http://www.obviously.com/recycle/

Materials for the Future Foundation
http://www.materials4future.org/PUBS/pubs2.html

Natural Resources Defense Council
http://www.nrdc.org/cities/recycling/default.asp

Use Less Stuff
http://www.use-less-stuff.com/

Zero Waste America
http://zerowasteamerica.org

APPENDIX E
Government Agency Information Resources
On Waste-Related and Environmental Issues

Adopt-a-Highway

Volunteer litter clean-up program along Illinois highways.

Ruth Ann Payne
Adopt-a-Highway Coordinator
Illinois Department of Transportation
201 West Center Court
Schaumburg, IL 60196-1096

Phone: 847/705-4077
Fax: 847/705-4666
Web site: *http://www.dot.state.il/aah.html*

Federal Recycling Programs

Information and materials regarding federal recycling programs and legislation.

Office of the Federal Environmental Executive
Mail Code 1600 S
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Phone: 202/260-1297
Web site*: http://www.ofee.gov*

Central Management Services State I-Cycle Program

Recycling programs in state office buildings, including such materials as paper, grease, corrugated cardboard, tin cans, etc.

Chip Gass, State Recycling Coordinator
Illinois Department of Central Management Services
1924 South 10 ½ Street
Springfield, IL 62703

Phone: 217/524-5742
Fax: 217/785-6905
TDD: 800/526-0844
E-mail: Chip_Gass@ cms.state.il.us
Web site: *http://www.state.il.us/cms/property/icycle/default.htm*

Illinois Environmental Protection Agency

Interactive games and presentations on the use of Environmental Pathways: Youth Investigating Pollution Issues In Illinois (a fifth-sixth grade guide to the environment).

Janet Hawes-Davis, Environmental Education Coordinator
Illinois Environmental Protection Agency
1021 North Grand Avenue East, MC #34
Springfield, IL 62794-9276

Phone: 217/524-8358
Fax: 217/557-2125
TDD: 217/782-9143
E-mail: Janet.Hawes-Davis@epa.state.il.us
Web site: *http://www.epa.state.il.us*

"Non-Hazardous Solid Waste Management Land fill Capacity in Illinois"

Annual report on municipal solid waste disposal and remaining landfill capacity, including county recycling rates. Also, interactive games and presentations on non-hazardous solid waste topics.

Ellen Robinson, Project Manager
Illinois Environmental Protection Agency
Bureau of Land
Waste Reduction & Compliance Section
1021 North Grand Avenue East
Springfield, IL 62794-9276

Phone: 217/782-9288
Fax: 217/782-9290
TDD: 217/782-9143
E-mail: ellen.robinson@epa.state.il.us
Web site: *http://www.epa.state.il.us*

Pesticide Container Recycling

Illinois statewide program focusing on recycling #2 HDPE agrichemical containers.

Susan Barron, Program Manager
Illinois Department of Agriculture
Bureau of Environmental Programs
P.O. Box 19281, State Fairgrounds
Springfield, IL 62794-9281

Phone: 217/785-2427
Fax: 217/524-4882
TDD: 217/234-4052
E-mail: sbarron@agr.state.il.us
Web site: *http://www.agr.state.il.us*

Project Learning Tree, Project WET and Project WILD

National environmental education curricula.

Randy Wiseman, Education Specialist
Illinois Department of Natural Resources
Division of Education
One Natural Resources Way
Springfield, IL 62702-1270

Phone: 217/524-4126
Fax: 217/782-5177
TDD: 217/782-9175
E-mail: rwiseman@dnrmail.state.il.us
Web site: *http://www.dnr.state.il.us*

Illinois School Recycling and Waste Reduction Grants

Grant funds for Illinois public and private schools to create or expand recycling programs.

Bina Fleck, Program Manager
Illinois Department of Commerce and Economic Opportunity
Bureau of Energy and Recycling
620 East Adams Street
Springfield, IL 62701-1615

Phone: 217/524-1838
Fax: 217/785-2618
TDD: 800/785-6055
E-mail: bina_fleck@commerce.state.il.us
Web site: *http://www.illinoisrecycles.com*

4Rs Newsletter, Recycling Information

Educational materials, curricula, vermicomposting ,and newsletters.

Brett Ivers, Recycling Educator
Illinois Department of Commerce and Economic Opportunity
Bureau of Energy and Recycling
620 East Adams Street
Springfield, IL. 62701-1615

Phone: 217/524-5859
Fax: 217/785-2618
TDD: 800/785-6055
E-mail: brett_ivers@commerce.state.il.us
Web site: *http://www.illinoisrecycles.com*

Technical Assistance on Waste Management and Research Issues

Ken Barnes or
Todd Rusk
Illinois Department of Natural Resources
Illinois Waste Management and Research Center
University of Illinois
One East Hazelwood Drive
Champaign, IL 61820-7465

Phone: 217/333-8940
Toll Free: 800/407-0261
Fax: 217/333-8944
TDD: 217/782-9175
E-mail: kbarnes@wmrc.uiuc.edu
trusk@wmrc.uiuc.edu
Web site: *http://www.wmrc.uiuc.edu*